CORE ENTREPRENEURIAL COMPETENCIES FOR CIVIL ENGINEERS TO BE SUCCESSFUL ENTREPRENEURS

by

Jan Adriaan van der Westhuizen

216075682

A dissertation submitted in fulfillment of the requirements for the degree of

Master of Science in Civil Engineering

College of Agriculture, Engineering and Science, School of Engineering, Construction Studies Discipline, University of KwaZulu-Natal

1 December 2017

Supervisor: Prof TC Haupt

COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE

DECLARATION - PLAGIARISM

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ACKNOWLEDGEMENTS

No undertaking of a project as intense as this study is possible without the contribution of many people. It is not possible to single out all those who offered support and encouragement during what at times seemed to be a 'never ending journey'. However, there are individuals without whom this study would not have been completed, and to them go my special thanks and acknowledgement of their contributions.

Firstly, I am indebted to my supervisor, Prof. T. C. Haupt for his expertise and patience.

I want to thank the acting VC, Prof. M Ramogale of MUT for having faith in me and allowing me to take time off to complete my MSc in Civil Engineering.

I also want to thank our Heavenly Father, through Jesus Christ, for giving me the strength and courage to complete this study and to my wife, Louisa, my two sons, Roan and Iwan as well as a friend of mine, Joseph Bwapwa, for being my inspiration and motivation.

ABSTRACT AND KEYWORDS

Purpose: Since entrepreneurship is viewed as a path to sustainable economic development, this study examined the managerial and entrepreneurial competencies necessary for entrepreneurial action.

Design/methodology/approach: This study did not make use of a sample to generalise the findings to a particular population other than to select respondents that are entrepreneurial practising civil engineers from the Durban branch of the South African Institute of Civil Engineers (SAICE) database. This simplified the complexity of the sampling technique, because the SAICE database is made up of reliable information in terms of the respondents' profile. This is done in order to gather credible information or data that will assist in achieving the study objectives. Furthermore, online surveys have been conducted to collect the data using the SAICE database for KwaZulu Natal, to determine the relative importance of 13 core entrepreneurial competencies to be successful as entrepreneurs. The mixed method approach was used, because of the nature of the study that required both qualitative and quantitative approaches.

For this study, questionnaires were distributed to 88 entrepreneurial civil engineers practicing in the Kwazulu-Natal province of South Africa, by means of a bulk email, about their views on core entrepreneurial competencies to be successful entrepreneurs.

Research limitations:

- There is seemingly a lack of data and statistics from successful civil engineers entrepreneurs for referencing purpose.
- This study will be undertaken with information collected in Kwazulu-Natal only.
- The sampled participants will not be an exact representation of the civil engineering entrepreneurs in South Africa, since the data was only obtained from one province in South Africa, due to time constraints.

Responses/Findings: There are competencies that are unique to the civil engineering discipline and it is necessary that education programmes need to construct curriculums that support the entrepreneurial endeavours of graduates. This study identified those competencies that are necessary for civil engineers to be successful entrepreneurs, an aspect of their education and training that has been ignored.

Practical implications: The findings provide guidance for the development of curriculums that are responsive to the development of these core competencies in civil engineering graduates.

Keywords: Entrepreneurship, civil engineering, competencies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 INTRODUCTION

1.1 Context of the problem

Efe (2014) scrutinised entrepreneurship education as a panacea for unemployment and poverty eradication for national security. The term *"entrepreneurship"* became an everyday buzzword, either in a macro context or in an individual context. In macro context it is believed to be an enabler of economy growth and development (Bernstein, 2011). Sondari (2014) stated that entrepreneurship activities are believed to be a tool to boost economy growth and to solve other economic problems such as unemployment. Given the increasing number of graduates who struggle to find employment post-university, entrepreneurship presents opportunities.

Entrepreneurship of entrepreneurial function entails:

- the discovery, assessment and utilisation of opportunities, regarding new products, services or production processes;
- new strategies and organizational forms and new markets for products and inputs that did not previously exist (Shane and Venkataraman, 2000).

In Civil Engineering, it is assumed that creativity and innovation are embedded qualities associated with the engineering profession. However it seems that engineering graduates very seldom explore the possibility of starting up an engineering business as a career option, but inevitably will upon completion of their studies endeavour to find a job at a multi-national company or multi-disciplinary practice. Self-employment by civil engineers is not presented to students as an alternative career, because the academic programmes are not designed to equip them to go out and set up their own practices.

Countries are progressively realizing the impact of entrepreneurship and implementing it as a means to increase employment and economic development. According to Sondari (2014) entrepreneurship activities are believed to be a tool to boost economy growth and to solve other economic problems such as unemployment. Analysing data from the World Bank shows that entrepreneurship might be a solution to the increasing number and growth of graduate unemployment. It is therefore necessary to find ways to create new entrepreneurs, right after or even before they graduated (Sondari, 2014). Therefore entrepreneurship education may play a role in promoting entrepreneurial intention among students.

According to Lambropoulosa et al. (2014), the recent global economic and financial crisis has led many countries into recession, which caused these countries to reduce both their public investment in infrastructure and private investment in buildings. As a result, the unemployment is particularly evident in the civil engineering and building sectors. These countries came to the conclusion that the professional development of newly graduated civil engineers is inconsistent to their study effort and qualifications. It is therefore vital for universities to plan and implement a transformation of the civil engineering syllabus with the objective to enable graduates to broaden their scope of their professional activity and increase their employability. As a result there should be an increase in the delivery of entrepreneurship education to engineering students through new courses, programmes and experiential learning opportunities. According to Abdulwahed et al. (2013), entrepreneurship education in engineering and technology is lacking in the majority of universities worldwide.

To prepare students for transformation of the civil engineering career path, universities became aware of the fact that they must graduate engineers who do not only understand science and technology, but should also be able to identify opportunities, understand market strategies, commercialize new products, and have leadership and communication skills. As a result there should be an increase in the delivery of entrepreneurship education to engineering students through new courses, programmes and experiential learning opportunities, a movement that has gained support from influential publications and professional organizations (Duval-Couetel et al., 2012). In a study done by Tynjälä and Gijbels (2012), the new generation of engineers is also expected to have skills in problem solving, networking, information technology and teamwork and be creative, have resilience, determination and taking risks to achieve their goals. Education specifically geared toward entrepreneurship or studying entrepreneurship in higher eduction could develop such skills (Seikkula-Leino, 2007). Therefore, entrepreneurship education is seen as a means to encourage future graduates to develop and adopt entrepreneurial mind-sets and skills (Antoncic and Hisrich, 2003).

1.2 Background

1.2.1 Core entrepreneurial competencies

A competency refers to the knowledge, skills, attitudes, values and behaviours that people need to successfully perform a particular activity or task (Brophy and Kiely, 2002). Thirteen competencies that are core to the entrepreneurship discipline were identified by Morris et al., (2013) in a major Delphi study. These competencies can be enhanced through exposure to a structured entrepreneurship education programme designed and taught at university. A desirable outcome of such a programme should be the transformation of students into successful

entrepreneurs that possess these core entrepreneurial competencies. Therefore, one of the key objectives of entrepreneurship education should be the creation of general awareness of what entrepreneurship actually entails.

1.2.2 Entrepreneurial competence

Morris, et al. (2013) indicated that entrepreneurship is viewed as a process that unfolds as individuals perform within and interact with their environments. Environments provide scripts that guide individual behaviours and interactions and education serves as an important source of scripts within the individual's environment. When placed in the context that centres on experiencing and performing real tasks that support entrepreneurial outcomes respondents may appear to demonstrate some competencies (Morris, et al., 2013). Only when entrepreneurship is seen as a unique and desirable discipline will the necessary competence be sought after and evident in graduates. The acquisition of entrepreneurial competence by students will result in new organizations and enterprises with them being responsible for deciding the structure of these entities and the allocation and sourcing of resources. Arguably, without entrepreneurial competence the opportunity will be missed for solving economic demands that lead to sustainable economic development (Birch, 1987).

1.2.3 Adequacy of university preparation

Entrepreneurial education is the process of providing individuals with the ability to recognize commercial opportunities and the insight, self-esteem, knowledge and skills to act on them. It includes instruction in opportunity recognition, commercialization of a product or service, securing resources in the face of risk, and initiating a business venture (Jones and English, 2004). It is argued that entrepreneurial education has to be a structured formal intervention designed by higher education institutions. There is a positive correlation between entrepreneurship education and the number of graduates who eventually become entrepreneurs instead of job-seekers. Arguably, in the absence of entrepreneurship education graduates from university will be poorly prepared for the real world of work and professional practice. Entrepreneurship education can lead to increased entrepreneurial intentions of students (Morris et al., 2013).

The 13 core competencies that were identified by Morris et al. (2013) could be integrated into the curriculum for entrepreneurship education to develop these specific competencies in students. These unique competencies can assist the content of entrepreneurship education programmes going forward. Research evidence suggests that entrepreneurship education can

produce a range of desired outcomes from increased entrepreneurial intentions to students becoming self-employed (Dickson et al., 2008).

1.2.4 Knowledge of entrepreneurship

According to Neck and Greene (2011), entrepreneurship is a domain of traits that can be learned and therefore can be taught. The new generation of engineers need not only to have a deep knowledge of the field of study but also several other skills. It has been argued that these additional skills can be developed through entrepreneurship education (Täks et al., 2014). Duval-Couetil et al. (2016) stated that it is necessary to explore the characteristics of entrepreneurship programme models that are most effective for engineering students in order to provide the engineering faculty and programme administrators with features to consider when developing entrepreneurship programmes targeting engineering students. Research that examines how several aspects of entrepreneurship programmes, including disciplinary focus, participation in experiential learning, and number of courses, impact student perceptions of their entrepreneurial knowledge and self-efficacy.

1.2.5 Entrepreneurial tasks

Understanding the activities of entrepreneurs, that is, what they actually do, when they start a venture is "perhaps the most under-researched aspect of the individual and venture creation" (Shook et al., 2003:390). The range of these activities is typically large. The attention and time given to these many and varied activities has to be balanced to ensure that they devote enough resources to key tasks (Baron, 2007). Of necessity entrepreneurs have to be involved in all aspects of the business, especially in the early stages of a new venture when they often are the business. These activities include strategic tasks, for example finding the idea, evaluating different options, constructing a business plan, choosing investors and key staff, and operational tasks like running a marketing campaign, keeping financial accounts, project managing the business, creating invoices, chasing up payments. Other important entrepreneurial tasks that will need to be done include, for example, estimating accurately the costs of running a new project, recruiting the right employees for a new project or venture, working with a supplier to get better prices to help a venture become successful, writing a clear and complete business plan and picking the right marketing approach for the introduction of a new service.

In the early stages of a venture, when the entrepreneur takes on these many and varied roles, the success of the venture can depend on the entrepreneur's ability to find a balance between different tasks. Spending too much time on, for example, constructing a comprehensive and

professional business plan can come at the expense of marketing activities to raise the profile of the business with potential customers.

To date, few researchers have examined to what extent different programme models and experiential activities impact respondent's perceptions of their entrepreneurial knowledge, skills, and self-efficacy. Findings indicate that higher perceptions of entrepreneurial knowledge were associated with the number of entrepreneurship courses taken and involvement in experiential learning activities (Duval-Couetil, et al., 2016).

1.3 Problem statement

The substantial lack of civil engineering entrepreneurial skills coupled with the absence of entrepreneurial civil engineering training combined with a non-conducive environment prevent civil engineering graduates to become successful entrepreneurs.

1.4 Hypothesis

- **Hypothesis 1:** The entrepreneurial competence of civil engineering graduates impacts the ability of the graduates to become successful entrepreneurs through increased core entrepreneurial competencies.
- **Hypothesis 2:** Inadequate university preparation impacts negatively to core entrepreneurial competencies for civil engineers to become successful entrepreneurs.
- **Hypothesis 3:** Knowledge of entrepreneurship improves with increased core entrepreneurial competencies.
- **Hypothesis 4:** Entrepreneurial tasks performed by civil engineers lower with increased core entrepreneurial competencies.

1.5 Objectives

- To analyse the entrepreneurial competence of practicing civil engineering graduates.
- To explore the impact of university preparation for civil engineering graduates in terms of core entrepreneurial competencies.
- To determine the knowledge that civil engineering graduates have of entrepreneurship.
- To analyse the entrepreneurial tasks that civil engineers perform in relationship with core entrepreneurial competencies.

1.6 Methodology

The approach that will be used in this study is shown in figure 1-1.

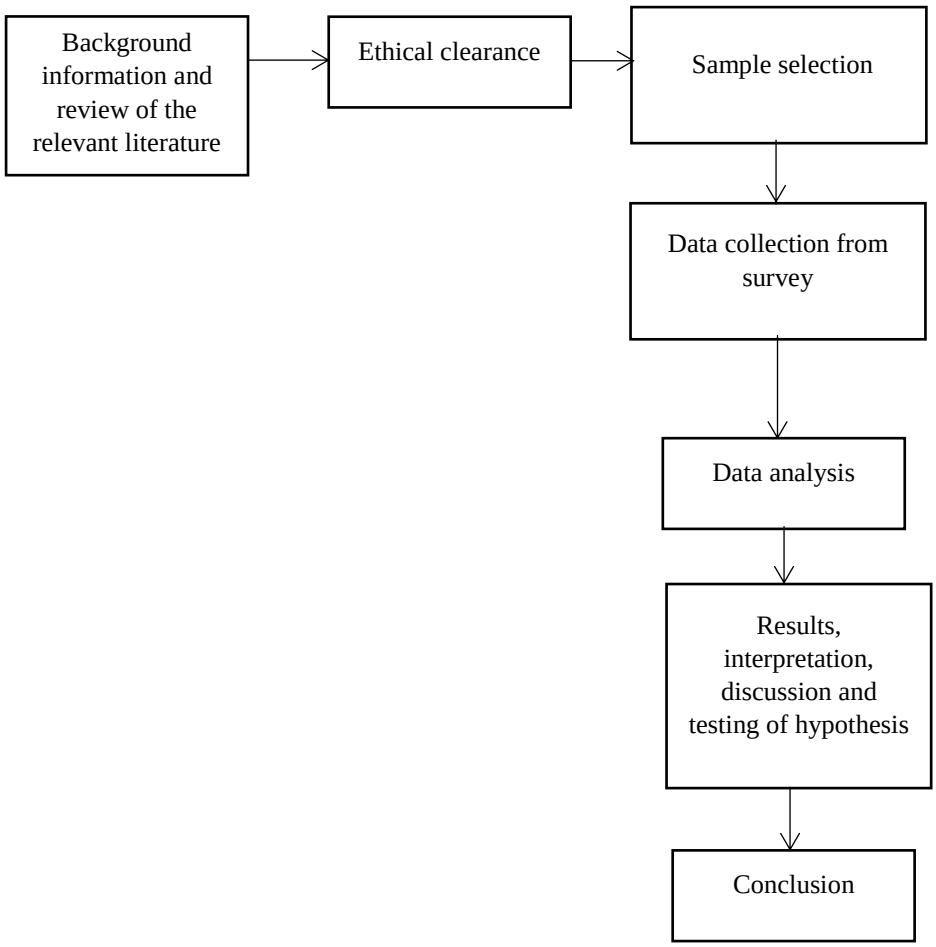

Figure 1-1: Methodological approach

1.6.1 Research Method

In order to achieve the objectives of this study, the quantitative research method will be used as the most appropriate for this study constantly bearing in mind the principal research question and the resources available for this study.

1.6.2 Ethical considerations

To sustain internationally acknowledged ethical standards, the following will be adhere to in this study:

- No reference will be made to names of individuals or companies. In this way, anonymity will be ensured, since no individual or company can be linked to the research instrument;
- No financial compensation in any manner or form will be offered to respondents for participation in this study;
- Quality assurance will be accomplished by correctness of data capturing and accuracy in calculations.

1.6.3 Data collection

A sample will be surveyed comprising of 88 civil engineers practicing in the Kwazulu-Natal province of South Africa about their views on core entrepreneurial competencies to be successful entrepreneurs. The data will be collected via a quantitative questionnaire survey.

1.6.4 Data analysis

Descriptive statistics will be derived using SPSS v24 and presented including measures of central tendency and dispersion. The internal validity of scaled responses will be determined by the Cronbach's alpha co-efficient for validity.

1.7 Locus of the study and resources

The sample of civil engineers will be drawn from the Durban branch of the South African Institute of Civil Engineers (SAICE) database.

1.8 Limitations of the study

- There is seemingly a lack of data and statistics from successful civil engineers entrepreneurs for referencing purpose.
- This study will be undertaken with information collected in Kwazulu-Natal only.
- The sampled participants will not be an exact representation of the civil engineering entrepreneurs in South Africa.

1.9 Study outline

The following are the chapters of the study:

Chapter 1: Introduction

This chapter focuses on the background of the study, which includes the problem statement, objectives, hypotheses to be tested and the significance of the study.

Chapter 2: The Review of Related Literature

This chapter provides an overview of the core entrepreneurial competencies that practising professional civil engineers should have to be successful entrepreneurs. This chapter is a critical analysis of similar previous studies , their outcomes and contributions as well as their weaknesses and strengths.

Chapter 3: Research methodology

This chapter discusses the research approach to the study, sampling techniques, data gathering strategies and statistical analysis of the data. Issues such as reliability and valididty as well as elimination of bias are discussed.

Chapter 4: Results and discussions

This chapter presents the findings of the study specifically with regards to testing the hypotheses. It discusses critically the analysis of these findings, and interprets the trends presented in tables and graphs.

Chapter 5: Conclusions and recommendations

This chapter is a summary of the study, followed by the conclusions of the results discussed in the previous chapter. The key findings will be discussed against those from previous studies and the literature. Inferential conclusions will be drawn from the findings and possible recommendations will be made for further study.

CHAPTER 2 REVIEW OF RELATED LITERATURE

2.1 Introduction

Sibiya (2013) mentioned that countries throughout the developed and developing world are confronted with increasing rates of unemployed graduates which also includes civil engineers. A possible method to curb both unemployment and the shortage of civil engineering skills can be through entrepreneurship education. Civil engineering education would then have to include significant coverage of entrepreneurship in terms of how to start, operate and grow a small business. Civil engineering graduates should be equipped to take a path of creating jobs rather than seeking one. By creation of this career path future civil engineers could be inspired. It should be basic knowledge that a student graduating with a civil engineering qualification is not yet experienced to register as a professional. Therefore it is vital that in addition to essential technical skills, civil engineers are expected to have effective communication, business and managerial skills, team working and leadership abilities, ethical and environmental awareness. These topics should be built into the teaching curriculum, but not at the expense of technical skills. It should not be forgotten that the key attributes of an engineer are a sound understanding of a technical engineering discipline and the ability to analyze, solve problems and evolve innovative solutions. According to Duval-Couetil. Reed-Roads and Haghighi (2012) labour markets are changing and presently engineers are expected not only to think like entrepreneurs, but also create new jobs. This new generation of engineers do not only need knowledge in their field, but also must have the ability to solve complex problems and must have the ability to work and communicate across disciplinary boundaries. Engineers need to evaluate markets and how to add value to customers, yet adhering to ethical standards to be able to meet the social, economic and environmental challenges. However, Täks (2015), Byers, Dorf and Nelson (2011), Jamieson and Lohmann (2011), Rae (2003), Rugacia et al. (2000), added that before problems can be solved, engineers must see the opportunities in problems, such as recognizing the opportunity for innovation, while Creed, Suuberg and Crawford (2002), Litzinger et al. (2011), Sawyer (2017) and Tynjälä and Gijbels (2012) indicated that engineers need to develop excellent communication and team-working skills so as to connect concepts from different interdisciplinary systems.

Entrepreneurship education addresses many of these skills. In order to overcome these challenges, entrepreneurship education needs to be introduced into scientific and technical studies within technical institutions (EU, 2006, 2008; Jamieson and Lohmann, 2009; National

Academy of Engineering, 2005). Shepherd (2004) claim that is also important to become resilient to failures and have determination in achieving set goals. Furthermore, entrepreneurship education is widely recognised for meeting future labour market demands, research work done on factors that affect the underlying learning processes remain rare (Lans et al., 2013). The extent, nature and outcomes of entrepreneurship programmes have not thoroughly been explored in scientific literature (Duval-Couetil et al., 2012; Duval-Couetil, 2013). According to Standish-Kuon and Rice (2002) an understanding of what entrepreneurship education within the engineering context is required and should be supported by scientific evidence.

2.2 Definition of entrepreneurship

Entrepreneurship is defined as the process of involving creation or seizing an opportunity, pursuing it regardless of the resources currently controlled (Timmons, 2009). It includes many aspects such as initiating, building and expanding an enterprise or organisation with the ultimate aim of manipulating an opportunity in the marketplace for long-term gain (Van Aardt et al., 2000). Both groups of authors have emphasised that the exploitation of an opportunity is undertaken in an environment with limited resources. Lowe and Marriott (2006) recognised entrepreneurship as being business ownership and a learnable skill. Entrepreneurship, like any other skill or competency is something that people can learn and develop. This is done through a process or a formal training to equip individuals with some skills and competencies before they become entrepreneurs. Eisenmann (2013) stated that Howard Stevenson, a Professor at Harvard Business School, defined entrepreneurship as the pursuit of opportunity beyond resources controlled, where:

"Pursuit" implies that entrepreneurs perceive a short window of opportunity and therefore need to show progress to enable them to attract resources.

"Opportunity" implies:

- pioneering an innovative product;
- devising a new business model;
- creating a better or cheaper version of an existing product; or
- targeting an existing product to new sets of customers.

"Beyond resources controlled" implies resource constraints.

This differs from Lowe and Marriott (2006) who reduced entrepreneurship to ownership and a learnable skill.

2.3 Definition of competency

According to Man et al. (2002) entrepreneurial competencies can be defined as higher-level characteristics covering personality traits, skills and knowledge. This can be seen as the ability of the entrepreneur to perform a job successfully. However, Dooley et al. (2004) defined competency-based behaviour as performance capabilities needed to demonstrate knowledge, skill and ability acquisition. Consequently, based on the conceptual definition from these authors, competency can be defined in relationship with the attributes of an individual. These attributes are strongly correlated to effective performance. Therefore, these authors have finally defined competency as a fundamental characteristic of an individual that is directly related to criterion-referenced effective and/or superior performance in a job or task. Therefore, five characteristics of competency, namely, motives, traits, self-concept, knowledge and skill can be outlined from many definitions of competency. Cheetham and Chivers (1996) reported that a model of professional competency differentiates *"cognitive"*, *"functional"* and *"meta"* competencies. They also reported that "cognitive" competence includes the theory and concepts which are relevant to a specific domain and knowledge acquired from experience. These attributes relay to the possession of work related knowledge and the ability to practice or put it to effective use. "Functional" competence was defined by the same authors as something which a person who works in a given field or domain should be able to do and be able to demonstrate with effectiveness. Also, it is alleged from their study that *"personal"* competence indicates a fairly lasting characteristic of a person strongly related to real performance in a job or task. For instance, the ethical behaviour and displaying personal traits of flexibility, integrity and trustworthiness are critical skills for managers, mostly in small to medium enterprises, but this might also be valid for larger corporations, because the individual is thought to be the centre of the concept of competency. Furthermore, *"meta"* competence is reported in the same study to be the highest level of abilities dealing with learning, adaptation, anticipation and creation. It is, however, important to highlight the fact that aspects or attributes such as communication, self-development, creativity, analysis and problem solving are also key aspects in the definition of "meta" competence for developing entrepreneurship. A number of studies has revealed that there are various aspects that focuses on entrepreneurial competencies.

Studies from different authors emphasised the different aspects of a range of competencies. This is also applicable in the field or domain of civil engineering that has many requirements in terms of competency that involves creativity, innovation, ethics, integrity and so many other attributes which concur with the three aspects of competency as discussed in this section.

2.4 Entrepreneurial core competencies

Entrepreneurial competencies are a set of characteristics associated with the expansion or development of a new business (Colombo and Grilli, 2005). They are defined as the key aspects underlying the characteristics of an individual that can result in an effective outcome, which can be the job or task performed. These competences represent the skills that an individual has acquired over a period of time. Consequently, the knowledge has been accumulated as well as the development of core skills sets (Boyd, 2012). According to Mitchelmore and Rowley (2010), core competencies can range from personality traits and individual motivation to specific knowledge and skills. .Nevertheless, there are many factors that impact a growing business especially for new entrepreneurs, it is therefore challenging to identify core competencies that can have a significant influence on the success of new businesses. It is important to highlight the fact that many external factors such as funding, market shares, competition and other factors will affect the success of a business. However, the individual characteristics of the entrepreneur, being the decision maker will also affect the business success (Ditkoff, 2010). In conclusion, entrepreneur competencies need to be nurtured in individuals before they undertake any further steps to start a business. In the case of civil engineers there is a need to foster these skills in students while they are learning the basics. There should be a combination of technical knowledge and business or entrepreneurship principles imparted to civil engineering students in order to get them prepared for the entrepreneur world.

2.5 Layers of core competencies

Core competencies consist of many characteristics known as key attributes that are applicable to all entrepreneurs. It is possible that some of these core competencies might be more universal than others. This may depend on factors such as the entrepreneur environment, the industrial type and the individual abilities or potential to become a pronounced entrepreneur. Many studies have portrayed core competencies in a pyramidal shape showing various layers of core competencies. Figure 2-1 presents the layers of competencies that are beneficial for entrepreneurs in different industries. In the context of this study these layers of competencies are core aspects and key elements needed to nurture the profile of future civil engineering entrepreneurs. The current education system has the responsibility regarding this situation to incorporate topics or relevant subjects to stimulate these attributes in order to prepare effective civil engineering entrepreneurs. From Figure 2-1 it is obvious to conclude that education competencies and personal competencies constitute the basis or backbone needed to produce an effective entrepreneur.

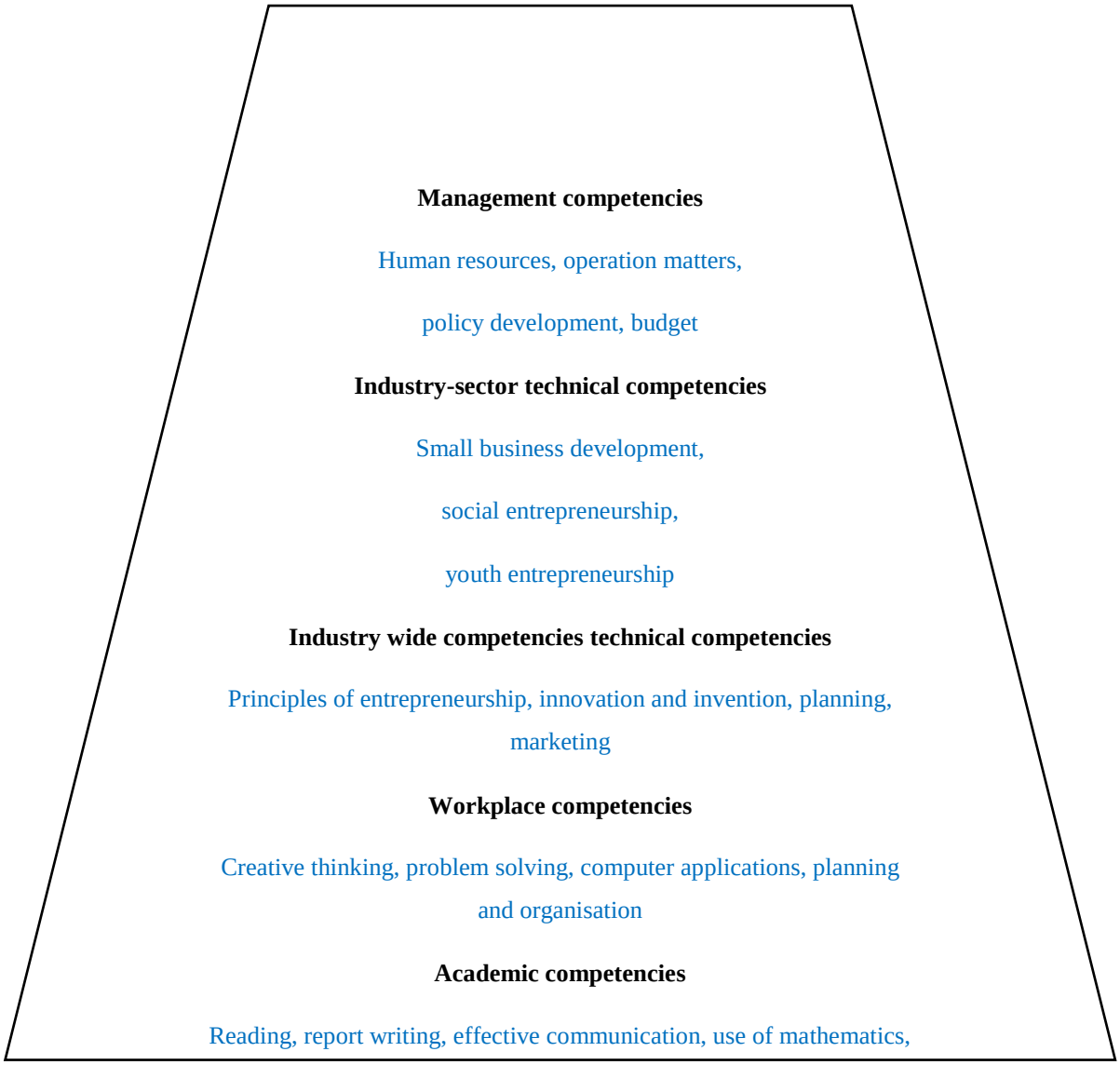

Figure 2-1: Layers of competencies model developed by Consortium for Entrepreneurship Education (adapted from Ventureprise, 2013)

2.6 Entrepreneurial characteristics

Entrepreneurship is studied from viewpoints of different disciplines which include engineering, health, tourism, food and telecommunications. In these studies it has been noted that there is a trend of focusing more on quality at the expense of other characteristics. This transpired in a study undertaken by Jaafar et al., (2004) regarding entrepreneurship. They assessed entrepreneurship by using two theories or concepts: *"locus of control"* and *"need for achievement"*.

However, Lowe and Marriott (2006) highlighted traits in their study, which include initiative, persuasive powers, ability to connect with other people, moderate risk-taking ability, flexibility,

creativity, independence, problem-solving skills, foresight, a need for achievement, imagination, positive response to changes, self-confidence, leadership, perseverance, energy, resourcefulness and profit orientation.

These are highly needed characteristics that future entrepreneurs have to acquire before they make the decision to embark on an entrepreneurship venture. Programmes provided at tertiary institutions in various disciplines have to focus on developing and stimulating their students on these attributes. For instance, currently civil engineering students are being taught with more emphasis on the technical side and with less focus on the personal effective development side.

Duermyer (2017) mentioned that the entrepreneurial ambition is instinctive, an attribute acquired at birth, but other authors disagreed and believed that anyone can become an entrepreneur. So whether a person is born to it or develops it, there are certain characteristics and traits required to be a successful entrepreneurship:

- **Passion** - Pursuing one's passion is one of the best predictors of success.
- **Independent thinking** - Entrepreneurs should often think outside the box.
- **Optimism** - Entrepreneurs should be visionaries and be certain that their ideas are possible.
- **Self-confidence** - Entrepreneurs should believe they can achieve their goal.
- **Resourceful and problem solvers** - Entrepreneurs never let problems and challenges get in the way, they rather find ways to achieve their goals.
- **Tenacity and ability to overcome hardship** – Entrepreneurs should not consider failure as an option.
- **Vision** - Vision is the energy that drives you forward toward your goal.
- **Focus** - Successful entrepreneurs should be focused on what will bring positive results.
- **Action oriented** – Entrepreneurs should be doers and therefore overcome challenges.

It is very important that entrepreneurs, especially civil engineers who are involved in small and medium businesses or even larger businesses should apply these skills in projects such as infrastructure development and water supply.

Figure 2-1 also highlights the importance of acquiring these skills when it comes to requirements needed for certain competencies. Additionally, Zeelie et al., (2004) have identified three types of competencies associated to entrepreneurial skills. These are pro-activeness, achievement orientation, efficiency orientation and commitment to others. *"Pro-activeness"* involves components such as initiative and assertiveness. *"Achievement orientation"* consists of seeing and acting on opportunities and *"efficiency orientation"*, is concerned with high quality of work and systematic planning. *"Commitment to others"* comprises matters including commitment to work contracts and recognition of the importance

of business relationships. It is important to note the fact that Zeelie et al (2004) and Lowe and Marriott (2006) highlighted characteristics that are covered in Jaafar et al., (2004), which was focusing on need for achievement and locus of control as mentioned before. They reported that entrepreneurs present a unique personality based on the ability to raise capital and willing to take risks.

Hale (2012), an entrepreneur asked the question: "*Does your business success or failure depend on what you do? Or what the world does to you?*" The answer of this question depends on an individual's own personal *"locus of control"*. Locus of control simply refers to how much individuals rely on how they can control actions that affect them. Seemingly your locus (in Latin it means *"place"* or *"location"*) can be either internal or external. An internal locus of control means you think you are in control of your life in such a way that if you succeed, you take the acknowledgement thereof and if you fail, you blame it on yourself, but If you consider yourself having an external locus of control you are of the opinion that other people, your environment and/or a higher power controls your fate and that implies that you blame everyone else but yourself. Jaafar et al., (2004) reported that *"need for achievement"* is assessed on the basis of work ethic, the pursuit of excellence, mastery and dominance. They also reported that entrepreneurial characteristics are directly associated to a company's performance. Furthermore, the educational level or qualification can also be related to performance. This was confirmed in their Malaysian study in which it was found that only educational level was showing a meaningful correlation with business performance. Industrial experience and age do not have a direct relationship with performance, because when an individual is well informed and trained the work output will be a true reflection of the capacity of the trained individual. However, it is important to mention that the locus of control factors also does not explain business success. In South Africa, generally it has been found that the owners/managers of emerging small contractor companies lack technical and managerial skills. Entrepreneurial characteristics of owners/managers are closely related to the success of the business, they are the foundation of core competences needed in order to be a successful entrepreneur.

Nevertheless, Huck and McEwen (1991) presented the argument that programmes and strategies that worked in one country may not work in another due to cultural and government differences and approaches. Their study in Jamaica focused on 12 competence areas including the starting of a business, planning and budgeting, management, marketing/selling, advertising, sales promotion, merchandising, finance and accounting, personal relations, purchasing, production, facilities and equipment and controlling risks. The rating of management is high on their list due to the fact that they found their entrepreneurs lacking management experience. Chandler and Jansen (1992) analysed three major roles that new entrepreneurs should

participate in for to be successful, namely, that of entrepreneurial, managerial and technical competence. Entrepreneurial competence relays to ones capacity to identify business prospects and managerial competence requires conceptual, interpersonal and political skills (Ibid). They considered the entrepreneurial role as the ability to scan the environment in order to select favourable opportunities and articulate strategies effectively. Technical competence requires that the entrepreneur must have practical skills to allow easy use of tools required in his specialised field (Ibid).

They further reported that it is obvious that business education and experience in business management can help establish a strong foundation for future success. This point of view might not meet some views that are only focused on managerial competencies for probable success. In this study, it is also believed that the combination of business education and experience might be a key factor for success.

2.7 Factors impacting on entrepreneurship

Preeti (2016) wrote that entrepreneurship is an intricate occurrence influenced by the interaction of a variety of factors. Entrepreneurial activities is dependent upon a varying amalgamation of economic, social, political, psychological and other factors whereas the following factors contribute to the success of entrepreneurship:

- Personality Factors - such as the desire for control of their actions, risk tolerance and family experiences which include the environment, level of education, age and work history tolerance. Personal factors, becoming core competencies of entrepreneurs, include:
  - ✓ Inventiveness (does things before being asked for);
  - ✓ Hands-on (identification and utilization of opportunities);
  - ✓ Persistence (working against all odds to overcome difficulties);
  - ✓ Problem-solver (new ideas to achieve innovative results);
  - ✓ Self-confidence (sticks to decisions);
  - ✓ Self-critical (learning from his mistakes and experiences of others);
  - ✓ An organiser (gathers information, formulates a plan, and monitors performance);
  - ✓ Risk-taker (which is the basic quality).
- Environmental factors –which relates to the conditions in which an entrepreneur has to work.
- Political stability in a country is vital for a smooth economic endeavour.
- Socio-Economic Factors, such as:
  - ✓ Religion;
  - ✓ Family background;

- ✓ Level of Education;
- ✓ Sincerity of Entrepreneurship;
- ✓ Social Security;
- ✓ Investment capacity;
- ✓ Determination.

- Economic Factor - such as accessibility of finance, labour, land, availability of customers and suppliers are the factors that stimulate entrepreneurship.

Furthermore, Lowe and Marriott (2006) pointed out that personality, socialisation, life experiences and motivation constitute a set of variables that impact on entrepreneurial success or lack thereof. These factors are more associated with the individual self, confirming the fact that mind-set and environment can be very influential in the success. Therefore, civil engineering students who aspire to become entrepreneurs have to be prepared in terms of their mind-set and their environment.

2.8 Developing entrepreneurship

An important question to be raised can be: whether it is possible and beneficial to impart entrepreneurial skills on graduates after leaving school or when they are still in training. The fact is that entrepreneurship can be acquired through experience and training. Lowe and Marriott (2006) have reported that entrepreneurial skills are learnable and depend on the context. This clearly implies that they can be acquired through learning processes or exposure in the correct environment. They also established that entrepreneurial education should pursue to educate on entrepreneurship concepts, business knowledge across disciplines, talents and skills development, change of attitudes, promotion and support of entrepreneurial skills. Developing entrepreneurial skills among small to medium enterprise managers contribute to profitability and growth.

2.9 Entrepreneurial traits

2.9.1 Passion;

According to Locke (2000) passion is known as a core characteristic of wealth creation, it is considered as the most observed fact in entrepreneurial studies (Smilor, 1997), it is also identified as one of the main trait characteristics in successful leaders. It is the fuel that drive the idea and the vision to become an entrepreneur. Civil engineering students need to be aware of this trait and the education system should put emphasis on this aspect when imparting entrepreneurial skills to students or future entrepreneurs. Entrepreneurs with high level of

passion are able to challenge opportunities and trials with enthusiasm, they work hard during venture growth phases, witness a venture's successes and problems as if they were personal events (Locke, 2000).

2.9.2 Proactivity

Proactivity is the capacity to take action that will influence the individual life and produce environmental changes. Entrepreneurs have to take initiative followed by action and then they will persevere until they reach the point of materialising their dreams (Bateman and Crant, 1993). It is reported that entrepreneurs who are proactive use managerial strategies involving high levels of environmental scanning and long-range forecasting to allow them to identify new opportunities with a high success rate (Kickul and Gundry, 2002). It is obvious that proactivity should be part of the traits that should be enhanced during training to develop core competencies in civil engineering graduates or students for entrepreneurship.

2.9.3 Tenacity

Remarkable perseverance, involves sustaining goal-directed action, persistent motivation, unshakable ambition and energy, even when faced with difficulties (Baum and Locke, 2004). Some studies have confirmed the importance of tenacity in foreseeing an entrepreneur's willingness to confront challenges in the market (Gartner et al., 1991). Looking at the challenges faced by engineering students during the course of their studies, there is a possibility to believe that they have developed this trait. The workload and pressure under which they operate are elements that prepare them to easily develop this trait.

2.10 Entrepreneurial motivation

Motivation materialises by goals setting and self-efficacy. Entrepreneurs who are motivated to set goals, particularly business growth goals, increase the company's growth which will improve the company's performance and innovation (Baum et al., 2001). However, according to Bandura (1997) entrepreneurs need a high level of self-efficacy which is defined as a person's belief in their own ability, which is their task-specific self-confidence. Entrepreneurs with high self-efficacy will persevere even when facing setbacks, they take negative feedback more positively (Wally and Baum, 1994). This relates to tenacity trait and the mind-set of the entrepreneur discussed earlier. Studies have reported that founders of successful entrepreneurial firms have a high internal locus of control, this implies that they have substantial control over the outcome of circumstances or events (Shane et al., 2003).

Therefore, in the context of this research, an entrepreneur's motivation plays an important role, because it deals with the individual mind-set and belief system. It creates the need for

achievement, because it stimulates the individual to achieve something despite the challenges, but also the locus of control allows the individual to believe that their actions can directly affect an event, or that they can control an outcome (Rotter, 1990).

2.11 Entrepreneurship and engineering education

2.11.1 Developments and challenges in engineering education

Engineering education has been developed with the aim to enhance student learning. Litzinger (2011) highlighted that pedagogical changes such as team-based and 'authentic' project-based activities have been made in an effort to deepen students' conceptual knowledge, with positive results. However, reports on engineering education still state that these initiatives are inadequate to prepare students for the 21st century labour market. Seemingly the engineering curricula are strongly sequenced, highly technical and still based on traditional models, with imbalances between theory and practice (Creed et al., 2002; Jamieson and Lohmann. 2009; Kriewall and Mekemson, 2010). Kriewall and Mekemson (2010) emphasized the importance of entrepreneurially minded engineers.

Entrepreneurship has worldwide significance. It was found that in developed economics, entrepreneurial development in the form of new enterprises strengthen weakening economics (Gürol and Nuray, 2006; Kuratko, 2005). Matlay (2006) viewed entrepreneurship education as a panacea for dwindling economic activities in both developing and developed countries.

The European Commission Expert Group's (EG) Final Report (2008) to the European Commission (EC) and the Annual Report (2011) of the European Society for Engineering Education (SEFI) observed the challenges to develop technical and science curricula and the need for Higher Education to become more entrepreneurial by increasing their teaching scope of entrepreneurship. The same report suggests that business and economic studies at Higher Education Institutions should not be confused with entrepreneurship education. Business studies focus on economic theories, while entrepreneurship education focuses on creativity, innovation and self-employment.

Jamieson and Lohmann (2009) is of the opinion that by increasing the engineering knowledge base and learning through entrepreneurship, students should develop skills to survive and be successful in their future careers.

2.11.2 What is entrepreneurship education?

Arguments for the need to integrate entrepreneurship education into engineering education needs an explanation what is means. As entrepreneurship education can be embedded in

curricula or offered as a course, the Expert Group's (EG) Final Report (2008) to the European Commission (EC) defined entrepreneurship education as:

Entrepreneurship refers to the ability of individuals' to turn ideas into action. It includes creativity, innovation and risk-taking, as well as the ability to plan and manage projects in order to achieve objectives. This will support everyone's day-to-day life at home and society and makes employees more aware of the perspective of their work and better able to grasp opportunities. It provides a foundation for entrepreneurs to establish a social or a viable activity (European Commission, 2008). Gibb (2008) stated that entrepreneurship, in an educational context, is the individual or collectively the individual's behaviours, skills and attributes to help all types of organisations to create and cope with change and innovation which involve higher levels of ambiguity and complexity to achieve personal fulfilment and effectiveness. Entrepreneurial education is the process with which these behaviours are practised and supported.

According to Fayolle and Gailly, 2008; Gibb (2008); Pittaway and Cope, 2007; Pittaway and Thorpe, 2012, there seems to be an agreement that entrepreneurship learning should include:

- The identification of opportunities;
- Creative problem solving;
- Negotiation skills;
- Strategic and critical thinking;
- Networking;
- Risk managing;
- Instinctive decision making;
- Managing business holistically;
- Coping with failure;
- Being effective; and
- Knowing your markets and clients.

2.11.3 Entrepreneurship and entrepreneurship education in engineering

2.11.3.1 Entrepreneurs profiling:

- **Skills and Attributes of an Entrepreneur**

  An entrepreneur, according to Lo (2011), should be able to confront economic, potential and dynamic challenges with entrepreneurial attributes such as innovation,

self-confidence, creativity, risk taking, problem solving skills, professional business, management skills and the inclination for change.

Ryan et al., (2011) indicated that a potential entrepreneur should have personal characteristics such as teamwork and flexibility, while Guerrero, Rialp and Urbano (2008) mentioned innovativeness. Sánchez (2011) included self-efficacy and pro-activeness.

However, to become successful entrepreneurs there are three needs identified by Oosterbeek et al., (2010):

- ✓ The need for achievement – the individual sets high targets;
- ✓ The need for power – the individual's ability to control others through actions and behaviours;
- ✓ The need of independence – the motive behind entrepreneurship.

- **Effect of Environment on Entrepreneurial preference**

  Environment refers to the Higher Education culture, campus life, economical status and job satisfaction. Wang and Verzat (2011) stated that the environment surroundings of potential entrepreneurs, graduates and undergraduates has an impact on their entrepreneurial inclination. If these surroundings are favorable, students will be more committed to an entrepreneurial career.

2.11.4 Engineering students and entrepreneurship education

Higher Education institutions are aware that civil engineering graduates should not only understand science and technology anymore, but also must be able to identify opportunities, evaluate markets, commercialize new products and also have leadership and communication skill to promote them (Duval-Couetil et al., 2012). Furthermore, expansion of engineers' roles and responsibilities within engineering companies have exposed engineering students to entrepreneurship coursework and experiential learning opportunities according to Rover (2005).

Standish-Kuon and Rice (2002) stated that entrepreneurship programmes that primarily target engineering students are acknowledged as "technology entrepreneurship" or "engineering entrepreneurship". Duval-Couetil et al., (2016) agreed that additional research is necessary when engineering faculties develop entrepreneurship curriculum specific for engineers and they should ask the question: "What type and how much entrepreneurship education do engineering graduates need?"

2.11.5 Competencies-based perspective on entrepreneurship education

The purpose of this research is to determine competencies that are core to entrepreneurship and to provide measures to which these competencies can be developed through entrepreneurship education (Morris et. al., 2013). A competency refers to the knowledge, skills, attitudes, values and behaviours that people need to successfully perform a particular activity or task (Brophy and Kiely, 2002). Morris et al., (2013) undertook a Delphi study to identify competencies that are unique to the entrepreneurial context to be integrated into a curriculum to be scrutinized by accrediting professional bodies and other stakeholders within educational institutions. They identified 13 core competencies to the entrepreneurship discipline. These competencies point to:

- Behavioural competencies – such as opportunity recognition, opportunity assessment, resource leveraging and development business models;
- Attitudinal competencies – such as resilience, self-efficacy and tenacity.

Table 2-1: Core competencies unique to the entrepreneurship discipline (Morris et al., 2013; Duval-Couetil, N., 2013; Morris et al., 2014; Mitchelmore and Rowley, 2010)

COMPETENCY	DESCRIPTION
Risk Management/Mitigation	The taking of actions that reduce the probability of a risk occurring or reduce the potential impact if the risk were to occur
Creative problem solving/imaginativeness	The ability to relate previously unrelated objects or variables to produce novel and appropriate or useful outcomes
Self-efficacy	The ability to maintain a sense of self-confidence regarding one's ability to accomplish a particular task or attain a level of performance
Value creation	Capabilities of developing new products, services, and/or business models that generate revenues exceeding their costs and produce sufficient user benefits to bring about a fair return
Building and using networks	Social interaction skills that enable an individual to establish, develop, and maintain sets of relationships with others who assist them in advancing their work or career
Opportunity Recognition	The capacity to perceive changed conditions or overlooked possibilities in the environment that represent potential sources of profit or return to a venture
Opportunity Assessment	The ability to evaluate the content structure of opportunities to accurate determine their relative attractiveness
Resilience	The ability to cope with stresses and disturbances such that one remains well, recovers, or event thrives in the face of adversity
Maintain focus yet adapt	The ability to balance an emphasis on goal achievement and the strategic direction of the organization while addressing the need to identify and pursue actions to improve the fit between an organization and developments in the external environments
Tenacity/Perseverance	The ability to sustain goal-directed action and energy when confronting difficulties and obstacles that impede goal achievement
Conveying a compelling vision	The ability to conceive an image of a future organizational state and to articulate that image in a manner that empowers followers to enact it
Guerrilla skills	The capacity to take advantage of one's surroundings, employ unconventional, low cost tactics not recognized by others, and do more with less
Resource leveraging	Skills at accessing resources one does not necessarily own or control to accomplish personal ends

These core competencies can be used to develop the content of entrepreneurship education. In addition to this, Higgins and Elliot (2011) suggested that emphasize on experiential learning in education programmes is needed.

Morris et al. (2013) mentioned that competencies are developed, rather that bequeathed, over time, but education can play a role in the development process by providing the key performance areas such as norms, values and rules that guide appropriate behaviours and mold the attitudes and behaviours of students into competencies.

Stones (2005), defined three broad categories of building blocks or scripts, namely that of:

- Signification - how individuals search for environmental changes, such as opportunity recognition and vision-based competencies;
- Legitimation – how individuals interpret this change, such as opportunity assessment and creative problem-solving competencies;
- Domination – how individuals respond this change, such as to assist in developing resource leveraging, value creation or guerrilla marketing skills.

Educational programmes need to be constructed in such a way that students should develop behavioural and attitudinal competencies to support their entrepreneurial activities (Morris et al., 2013).

Researchers have also distinguished *"stable"* and *"dynamic"* competencies (Leiba-O'Sullivan 1999; Tannenbaum and Yukl 1992). Stable competencies defines the natural ability and emotional stability, which are relatively static and therefore constrain one's prospective to develop a skill. On the other hand, dynamic competencies are those that can be developed, such as stress management skills, self-efficacy and one's knowledge on a specific topic. Bergevoet and Van Woerkum's (2006) view is that dynamic competencies can be improved through training and practice.

Morris et al., (2013), showed that education serves as a platform to transform students into successful entrepreneurs that personify key entrepreneurial competencies. D'Orazio, Monaco and Palumbo (2012), indicated the importance of introducing entrepreneurship training and development of skills at higher education institutions as a way for teaching entrepreneurial activities as part of emergent entrepreneurial SMMEs (micro, small and medium-sized enterprises).

2.12 Civil engineering career path change

Fatoki and Odeyemi (2010) concluded in their research that, due to South Africa's current high unemployment rate, it should be expected that SMMEs should be considered as an important mechanism to address the challenges of job creation, economic growth and development. They also stated that SMMEs form an important source of innovation when considering new products, services and technology. Therefore, it is clear that both small and medium enterprises

should play a more significant role in the South African economy (Fatoki and Odeyemi, 2010). However, due to the absence of entrepreneurship training in the core curriculum of civil engineers in South Africa these pipeline students must consider a career path change towards entrepreneurship.

2.13 Legislation promoting SMMEs in South Africa

South African National Small Business Act no 102 of 1996

In South Africa, the National Small Business Act (Act No. 102 of 1996) defines micro, small and medium sized enterprises (SMMEs) and summarized by Mohsam and Van Brakel (2011), as:

… a separate and distinct business entity, including co-operative enterprises and non-governmental organizations, managed by one owner or more which, including its branches or subsidiaries, if any, is predominantly carried on in any sector or sub-sector of the economy … and which can be classified as a micro-, a very small, a small or medium enterprise by satisfying the criteria … opposite the smallest relevant size or class … (South Africa Government, 1996).

The Act further defines a small business organisation as:

... any entity, whether or not incorporated or registered under any law, which consists mainly of persons carrying on small business concerns in any economic sector, or which has been established for the purpose of promoting the interest of or representing small business concerns, and includes any federation consisting wholly or partly of such association, and also any branch of such organization (South Africa Government, 1996).

Selai (2006) extract from The National Small Business Act of 1996 that SMMEs categorized as:

- **Micro-enterprises**

With no more than 5 paid employees. This category incorporates the survivalist group of enterprises, which generate income less than the poverty line, have no paid employees and minimal asset value.

- **Very small**

Fewer than 10 paid employees, except in mining, electricity, manufacturing and construction, where the upper limit is 20. Enterprises operate on the formal market and have access to modern technology. Lower limit: self-employed e.g. artisans, professionals (Limits are rather fluid).

- **Small**

Fewer than 50 employees. Enterprises are generally more established than the very small class, with more complex business practices. They have often outgrown direct supervision by the entrepreneur and developed a secondary coordinating mechanism.

- **Medium**

Maximum of 100 employees, except in mining, electricity, manufacturing and construction, where the upper limit is 200. Enterprises are still owner-managed and controlled, but have more complex structures, often an additional management layer and division of labour (Selai, 2006).

2.14 Core competencies: main focus of the current study

Many aspects from various authors have been reviewed in this chapter and is summarized in table 2-2.

Table 2-2: Main core competencies unique to the entrepreneurship discipline

Identified Competency	Huck and McEwen (1992)	Leiba-O'Sullivan (1999)	Locke (2000)	Ryan et al., (2011)	Tung (2011)	Guerrero and Sánchez (2011)	Morris, et al. (2013)	Preeti (2016)	Duermyer (2017)
Risk Management/Mitigation	✓	✓		✓	✓		✓	✓	
Creative problem solving/imaginativeness					✓		✓	✓	✓
Self-efficacy		✓			✓	✓	✓		✓
Value creation							✓		✓
Building and using networks							✓		
Opportunity Recognition						✓	✓		✓
Opportunity Assessment							✓		
Resilience							✓		✓
Maintain focus yet adapt							✓		✓
Tenacity/Perseverance							✓	✓	
Conveying a compelling vision							✓		✓
Guerrilla skills							✓		
Resource leveraging			✓				✓		✓

There are many entrepreneurial core competences as revealed in the course of this chapter. The analysis of table 2-2 clearly indicates and has confirmed their existence from many studies undertaken as shown. However, the 13 core competencies identified by Morris et al (2013) are found to be the most consistent from this analysis. Therefore, this study will focus on these 13 core competencies to analyse their contribution regarding the concept of entrepreneurship in details.

2.15 Summary of the literature

From the literature related to this research it appears that the success of an entrepreneur depends on many core competencies, traits and the environment. Therefore, education or training of future entrepreneurs is a key factor that will help to equip and empower students with the necessary tools in order to rather produce employment creators than employment seekers. Empowerment must be combined with entrepreneurial skills to produce quality entrepreneurs. Furthermore, training should match the needs of the society in order to produce qualified entrepreneurs. Once training is completed the environment/government/ private sector should provide the students with opportunities to grow. Inadequate training and lack of management skills are viewed as the main obstacles facing civil engineering graduates. This should be the responsibility of the education system which is a rigid structure and therefore it is not possible to implement subjects such as entrepreneurship and business/financial management in the curriculum. The entrepreneurial competencies, together with the managerial and technical competencies, are essential in developing sustainable entrepreneurs. From the literature 13 core entrepreneurial competencies were found to be the major ones and most important with significant influence on the entrepreneurship concept. These core competencies will be the focus of the current study. A critical analysis will assist in understanding the problem and the causes that hinder entrepreneurship skills for civil engineering students.

Therefore, the approach to be used for this research will be to use the 13 core entrepreneurial competencies (summarized in Table 1), to develop a set of measures that can be used to assess the mastering of all these competencies in an educational perspective for civil engineering students. Hills (1988) and Solomon, Duffy and Tarabishy (2002), mentioned that despite the increasing occurrence of entrepreneurship education at universities throughout the world, significant inconsistency remains in the content taught. Many programmes emphasize general business competencies over core entrepreneurial competencies. This research will also look at the education aspect, identify weaknesses, suggest and provide some guidelines in order to promote the entrepreneurship into the civil engineering education students in the South African context.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

Research design forms the basis towards the study of the problem after formulating the research problem. It is therefore the way in which data is collected and the analysis thereof with the aim to provide relevance of the research purpose.

This chapter deals with strategies, survey population, sampling design and procedures and will be presented as the methods of data collection, the processing thereof as well as the data analysis using SPSS.

The survey items in this study were developed as a result of an analysis of previous studies done by means of a review of the related literature. The study will have to answer to questions related to the capacity of civil engineering graduates to become job creators rather than the current situation of job seekers. Also the study will have to suggest on how to make current civil engineering graduates job creators. The study will identify from the findings some of the issues that hamper the entrepreneurship abilities of civil engineering graduates in the current context.

Therefore, there it is necessary to design an approach that will give answers to these questions and how the problem can be solved in case the study shows many weaknesses regarding the core competencies for graduates to be successful entrepreneurs.

3.2 Research design

Research design focuses on the end result and the process to achieve that outcome and is viewed as the functional plan in which research methods and procedures are combined to acquire reliable data for empirically grounded analyses, conclusions and theory formulations (Vosloo, 2014). Bless et al., (2006), define research design as operations to be performed, with the aim to test specific hypothesis under given conditions. Mouton (1996) stated that the main function of research design is to enable the researcher to anticipate what the research decisions are most likely to be and to maximise the validity of the results. In this study the relevant data will be collected with the aim to provide answers to the study on the role of entrepreneurial competency on the success of the SME's.

3.3 Research methodology

Methodology is the general theoretical perspective of the research, in other words, the overall nature of the research activity. There are two fundamental methodologies, namely, qualitative and quantitative (Pickard, 2013). Richards and Morse (2012) asserted that when the research problem is complex or the researcher is uncertain that one method or strategy may not comprehensively address the research problem, multiple research methods or approaches can be used. Mixed methodology is a research design that focuses on collecting, analysing and mixing both quantitative and qualitative approaches in different stages of the research process.

3.3.1 Qualitative research approach

According to Leedy and Ormrod (2005), qualitative research focuses on phenomena that occur in the "real world". Qualitative research also involves studying those phenomena in all its complexity. Therefore, qualitative research is rarely simple. Leedy and Ormrod (2005) added that qualitative research serves one or more of the following purposes:

- **Description**: revealing the nature of certain situations, settings, processes, relationships, systems or people.
- **Interpretation**: gaining insights into a particular phenomenon, developing new concepts or theoretical perspectives about the phenomenon and/or discovering problems that exist within the phenomenon.
- **Verification**: allowing the researcher to test the validity of certain assumptions, claims, theories, or generalisations in real-world contexts.
- **Evaluation**: providing a means through which a researcher can judge the effectiveness of particular policies, practices or innovations.

Advantages of qualitative research

- Qualitative research observes people as individuals, attempting to gather their subjective experience of an event.
- Unexpected results and insights can occur (Barker, 2013).

Disadvantages of qualitative research

Due to the individual, subjective nature of qualitative data,

- It is often difficult to make predictions for the wider population.
- It is lengthy to analyse, and
- Due to the open ended approach used in qualitative research it is difficult to test hypothesis (Barker, 2013).

3.3.1.1 Methods to conduct qualitative research

There are several different methods for conducting a qualitative research, but Leedy and Ormrod (2001) recommended the following five: Case studies, ethnography, grounded theory, phenomenological and content analysis.

Case Study: Creswell (2013) defined case study as the researcher that explores in depth a programme, an event, an activity, a process, or one or more individuals. Leedy and Ormrod (2001) showed that a case study must have a defined time frame. Creswell and Poth, (2017) recommended that the structure of a case study should be the problem, the context, the issues, and the lessons learned.

Advantages of case studies capacity is to manage a full collection of proof, inclusive of reports, objects, meetings and research as well as being a powerful way of portraying the project to an external audience. *Disadvantages* of a case study is that the data collection for a case study is broad and draws from multiple sources such as direct or participant observations, interviews, archival records or documents and audio-visual materials and the researcher will have to spend time on-site to interact with the people studied. (Merriam, 1988).

Ethnography Study: Ethnography studies an entire group that shares a mutual culture (Leedy & Ormrod, 2001). The focus is on everyday behaviours to identify norms, beliefs and social structures. Ethnography studies try to understand the changes in the group's culture over time. As a result, findings may be limited to generalization in other topics or theories. The first step in the ethnography process is to gain access to a site. Secondly, the researcher must establish relationships with the participants to build trust. Thirdly, the researcher intermingles with the participants in order to identify the key informants in the culture (Leedy & Ormrod, 2001). The data is collected from participant observations and from interviewing several key informants.

Advantages include the portrayal of an ordered image of a particular situation; results will be drawn from communities' lives which add value when the research has complicated themes. *Disadvantages* are that it is very strenuous on the researcher as ethnography deals with narration and therefore results are difficult to duplicate (Glüten and Awan, 2014).

Grounded Theory Study: Creswell (2013) defined grounded theory research as the *"researcher attempts to derive a general, abstract theory of a process, action, or*

interaction grounded in the views of participants in a study". Grounded theory research begins with data that develops into a theory. The term grounded provides the context of this method while the research requires that the theory must develop from the data collected in the field rather than taken from the research literature. Finally, a grounded theory report includes five aspects: describing the research question, literature review, describing the methodology, data analysis explaining the theory, and discussing the implications (Leedy and Ormrod, 2001).

Advantages of the grounded theory are the fact that it refrains from making assumptions; receives a more independent perspective of human activity in a social setting (Simmons, 2006); it creates a system to produce an attentiveness of social experiences, which is not predetermined created with current assumptions and ideal models (Engward, 2013); and it is also appropriate for examining social procedures that have limited former study consideration (Salkind, 2010). *Disadvantages* are that the grounded theory neglects to diagnose the commitment of the analyst and therefore obscuring his/her information development and understanding (Bryant & Charmaz, 2007); techniques have a tendency to create excessive information, which makes it problematic to oversee especially for the novice analyst; and it lacks guidelines for the understanding of groupings (Salkind, 2010).

Phenomenological Study: According to Leedy and Ormrod (2001), the purpose of this study is "to understand an experience from the participants' point of view". The focus is therefore on the participant's perceptions of the event or situation and the study tries to answer the question of that experience.

Advantages of this study are that it produces an insightful comprehension of an experience; the importance of understanding of basic encounters to related professions and policies; this is an effective method of information accumulation; it supports an organized approach to the novice analysts (Pinnegar and Daynes, 2006). *Disadvantages* of this method are that collecting data is through lengthy interviews, because it is important to understand and interpret a participant's perception on the meaning of an event (Creswell and Poth, 2017). Speziale, Streubert and Carpenter, (2011) regarded this method as harsh, basic, and regular.

Content Analysis Study: Leedy and Ormrod (2001) defined this method as *"a detailed and systematic examination of the contents of a particular body of materials for the purpose of identifying patterns, themes, or biases"*. In other word it reviews forms of

human communication such as books, newspapers and films as well as other forms for the purpose to identify patterns, themes, or preconceptions.

Advantages of a content analysis study are that it can allow for both quantitative and qualitative operations; it can provides valuable historical and/or cultural insights over time through analysis of texts; it provides insight into complex models of human thought and language use, is considered as a relatively *"precise"* research method. *Disadvantages* are that it can be extremely time consuming; it is lacking of theoretical base about the relationships and impacts implied in a study and can be difficult to computerize (Al Zadjali, 2011).

In summary, Creswell (2013) described how these methods meet different needs. For instance, case studies and the grounded theory research explore processes, activities, and events while ethnographic research analyses broad cultural-sharing behaviours of individuals or groups. Case studies as well as phenomenology can be used to study individuals.

3.3.2 Quantitative research approach

Quantitative research can be described as research that involves numbers and measurement and therefore emphasising frequencies and statistics. Struwig and Stead (2001) asserted that quantitative research requires that data be collected and expressed in numbers, while Leedy and Ormrod (2005) described it as the approach that yields quantitative information that can be summarised through statistical analysis. According to Gorman and Clayton (2005) quantitative researchers view the world as a collection of noticeable events and facts that can be measured. Pickard (2013) emphasised that quantitative research:

- Firstly, begins with a theoretical framework as established by the literature review;
- Secondly, develops a hypothesis and identifies variables within the hypothesis, which can be translated into research aims and objectives;
- Thirdly, the most appropriate research method must be used to be able to determine the sample and designs and data collection instruments within that method, and
- Fourthly collects data, processes and analyses it. When the data analysis is complete, there should usually be enough evidence to either deny or support the hypothesis. Generalisations are then made based on the findings, (Pickard, 2013; Struwig and Stead, 2001).

Advantages of quantitative research:

- It is the dominant approach in psychological research. It is concise, accurate and can be strictly controlled to ensure that the results are replicable and that causation is established.
- Quantitative data also has predictive power in that research can be generalised to a different setting.
- It can also be a lot faster and easier to analyse qualitative data (Barker, 2013).

Disadvantages of quantitative research:

- Quantitative data does not recognise the individuality of human beings and can be guilty of grouping people into set categories because it is easier to analyse;
- It can also oversimplify human nature. This form of research does not recognise the subjective nature of all social research, if we set out to prove a hypothesis, we aren't being entirely objective (Barker, 2013).

3.3.2.1 Quantitative research designs

There are four main types of quantitative research designs according to Walker (2005):

- **Descriptive**: Descriptive, or exploratory studies are used when little is known about a particular phenomenon. The researcher observes, describes, and documents various aspects of a phenomenon. There is no manipulation of variables or search for cause and effect related to the phenomenon. Descriptive designs describe what actually exists, determine the frequency with which it occurs, and categorizes the information.
- **Correlational**: Correlational designs involve the systematic investigation of the nature of relationships, or associations between and among variables, rather than direct cause-effect relationships.
- **Experimental**: True experimental designs examine the cause and effect relationships between independent (predictor) and dependent (outcome) variables under controlled conditions.
- **Quasi-experimental**: Quasi-experimental, like true-experimental designs, examine cause-and-effect relationships among independent and dependent variables. However, one of the characteristics of true experimental design is missing, typically the random assignment of subjects to groups. Although quasi-experimental designs are useful in testing the effectiveness of an intervention and are considered closer to natural settings, these research designs are exposed to a greater number of threats of internal and external validity, which may decrease confidence and generalization of the study's findings.

3.3.2.2 Information gathering techniques in quantitative research

According to Leedy and Ormrod (2001) the information gathering techniques refer to instruments used to gather information, of which the main ones include interviews and questionnaires.

Interviews: In quantitative research (also called survey research), interviews are more structured than in qualitative research. In a structured interview, the researcher asks a standard set of questions and nothing more (Leedy and Ormrod, 2001).

- **Face -to -face interviews:** *Advantages* are that this type of interview allows the researcher to establish a relationship with the potential participants and gain their cooperation; it yields the highest response rates in survey research; it allows the researcher to clarify vague answers and when appropriate, seek follow-up information. *Disadvantages* of this type of interview pose impractical when large samples are involved, is time consuming and expensive.
- **Telephone interviews:** *Advantages* are that it is less time consuming: it is less expensive and the researcher has ready access to anyone who has a telephone. *Disadvantages* are that the response rate is not as high as the face-to- face interview, but is significantly higher than the mailed questionnaire. Furthermore, the sample may be biased to the extent that people without phones are part of the population about whom the researcher wants to draw conclusions.
- **Computer Assisted Personal Interviewing:** This is a form of personal interviewing, but instead of completing a questionnaire, the interviewer uses a computer to enter the information directly into the database. The *advantage* of this type of interview is that it saves time involved in processing the data, and is as saving the interviewer from carrying around hundreds of questionnaires. However, the disadvantage is that this type of data collection method can be expensive to set up and requires that interviewers to have computer and typing skills.

- **Questionnaires:** According to Smith, (2012) a questionnaire is a list of questions and answers as recorded by the respondents. It is required of the respondents to read the questions, interpret what is expected of them and write down the answer. Therefore, questionnaires should be structured carefully to ensure that the questions are understandable as no interpretation is available, as with an interview. Monette et al. (2013) described a questionnaire as a manner to collect data in survey research that contains questions that participants respond on a questionnaire form itself, without the assistance of an interviewer.

The *advantage* of questionnaires is that it can be sent to a large number of people and saves the researcher time and money; respondents are more honest when responding to the questionnaires regarding contentious issues due to the fact that their responses are anonymous. *Disadvantages* are that the majority of the participants that receive questionnaires don't return them and those who do might not be representative of the originally selected sample (Leedy and Ormrod, 2001).

Subsequently, after careful investigation of the various alternative research methods in the literature, the quantitative research method was used as the most appropriate for this study, constantly bearing in mind the principal research question and the resources available for this study. This choice is justified by the fact that the study involved measurements and numbers reflected as reflected in the questionnaire sent to civil engineers who were the respondents.

Furthermore, the research objectives of the current study required measurable quantities to assess various correlations between constructs and its impact on the core entrepreneurial competencies. It was necessity to collect quantifiable parameters in order to generate credible conclusions, therefore, there should be a strong link between the chosen quantitative method and the objectives.

3.4 Research instrument design

Sincero (2012) stated that there are two types of questions:

Closed-Ended Questions: Closed-ended questions limit the answers of the respondents to response options provided on the questionnaire, which are designed to encourage a full and meaningful answer using the subject's own knowledge and/or feelings. It encourages a short or single-word answer, which cannot be answered by a simple "yes" or "no".

Advantages are that it is time-efficient; responses are easy to code and interpret and it is ideal for quantitative type of research. *Disadvantages* are that the respondents are required to choose a response that does not exactly reflect their answer and the researcher cannot further explore the meaning of the responses.

It is important for the researcher to make a decision on the recording technique for the responses on the questionnaires. A Likert scale will be used as recording technique for the questionnaire responses. The Likert rating scale requires an indication of the extent of the respondent's agreement (Vosloo, 2014). In this study a five-point Likert scale will be used to represent the extent of knowledge, opinion, judgement and experience of the respondents.

The instrument used for this study comprises of five constructs that contain closed-ended questions, designed to obtain responses to indicate a level of agreement on a 5-point Likert scale, where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree:

- 13 core entrepreneurial competencies questions;
- 14 aspects of entrepreneurial competence questions;
- 7 statements about university preparation of civil engineers for entrepreneurship questions;
- 37 entrepreneurship knowledge areas questions and
- 15 entrepreneurial tasks questions; and
- Period of which the respondent owned a civil engineering practice.

Open-Ended Questions: In open-ended questions, there are no pre-defined options or categories included, open-ended questions are those which require more thought and more than a simple one-word answer.

Advantages are that participants can respond to the questions exactly as how they would like to answer them and the researcher can investigate the meaning of the responses. *Disadvantages* are that it is time-consuming and responses are difficult to code and interpret.

This instrument contains only one open ended question designed to obtain responses from respondents about the number of years they have practised as a civil engineer.

3.5 Pilot study

The pilot study is a smaller study conducted prior to the larger research to determine whether the methodology, sampling, instruments and analysis are adequate (Bless et al. (2006). Piloting assists in eliminating ambiguous questions and will provide a guide for rephrasing questions to invite a better response (Boynton and Greenhalgh, 2004).

The researcher conducted a pilot study using the constructed questionnaire in Annexure 1, allowing for some feedback of the participants about their expertise in their respective civil engineering fields and how it could contribute to entrepreneurship training.

The pilot study was used as a testing or trial method to understand the terms, the importance and relevance of questions, their depth and how can they assist in generating reliable data and for the success of the study in the future. It therefore aims to improve the questionnaire before

doing the larger study, but it was found that no changes needed to be made to the instrument as it appeared that respondents were clear about the responses needed from the questionnaire.

3.6 The study population

The population in this study refers to the members of a group of people which can be defined as respondents to whom the research measurements refer by reported results, findings and inferences (Rubin and Babbie 2010). In this current study the size of the population is determined by the number civil engineering professionals in Kwazulu-Natal. There is a possibility to expand it to the national level with the assistance of the South African institution of civil engineers which is going to provide the national database for the needed profile of the respondents.

According to the membership statistic from SAICE (2017), there are 1,300 civil engineers and registered in the KwaZulu Natal province, which was regarded as the population for this study.

3.7 Sampling and sampling techniques

Sampling refers to the process of selecting a sample as a small portion from a defined population, with the intention of representing the population (McLeod, 2014). There are various **techniques for sampling**: *Random* sampling known as the best method of selecting samples from the population of interest. The advantages are that the sample should represent the target population and eliminate sampling bias, but the disadvantage is that it is very difficult to achieve. *Stratified* sampling in which a deliberated effort is made to make the sample representative of the target population. This method can be time consuming. The *volunteer* sampling is relatively convenient and ethical if it leads to informed consent however, it is unrepresentative as it leads to bias on the part of the participant. *Opportunity* sampling is quick, convenient and economical, therefore it is the most common sampling type in practice, however, it is also having the issue of unrepresentatively. Ellen (2012) stated that the *Slovin's formula* sampling technique is used when it is not possible to study an entire population, a smaller sample is taken using a *random* sampling technique. Slovin's formula allows a researcher to sample the population with a desired degree of accuracy. It gives the researcher an idea of how large his sample size needs to be to ensure a reasonable accuracy of results.

Therefore this study used a sample to generalise the findings of a particular population by selecting respondents that are entrepreneurial practising civil engineers from the Durban branch of the South African Institute of Civil Engineers (SAICE) database. This will simplify the complexity of sampling technique because the SAICE database is made of reliable information

in terms of the respondents' profile. This is done in order to gather credible information or data that will assist in achieving the study objectives.

Sampling size: The random sampling technique, using the Slovin's formula was used to calculate the sample size: n = N / (1 + Ne).

Where n = Number of samples, N = Total population and e = Error tolerance

Therefore the sample size was: $n = N / (1 + Ne^2)$

$= 1,300/ (1 + 1,300*0,1^2)$

= 93 respondents

The sample size for the study aimed is 93 derived from Slovin's formula.

3.8 Instrument administration

For this study, questionnaires were emailed directly to all entrepreneurial civil engineers practicing in the Kwazulu-Natal province of South Africa about their views on core entrepreneurial competencies to be successful professionals, as a bulk email from the Durban branch database of SAICE members comprising of 1,300 members. Data have been collected over a period of two weeks.

3.8.1 Data collection and analysis

The sample size of one hundred entrepreneurial civil engineers practicing in the Kwazulu-Natal province of South Africa responded, which was the preferred sample size and therefore deemed to be adequate.

The data was collected via a quantitative questionnaire survey comprising of several sections, namely core entrepreneurial competencies; aspects of entrepreneurial competence; statements about university preparation of civil engineers for entrepreneurship; entrepreneurship knowledge areas, and entrepreneurial tasks to which respondents were required to give a scaled response of agreement. Descriptive statistics were derived using the latest version of IBM SPSS Statistics 24 and presented including measures of central tendency and dispersion. The internal validity of scaled responses was determined by the Cronbach's alpha co-efficient for validity.

3.8.2 Follow-up procedures

From the SAICE database of email addresses, questionnaires were emailed on a weekly basis and the researcher collected the telephone numbers provided and phoned civil engineers on a weekly basis to improve the response rate.

3.8.3 Response rate

Vosloo (2014) states that regardless of the sampling method used, the challenge of non-responses to the survey is a reality. However, non-responses will not matter if there is certainty that non-respondents are very similar to respondents on all related variables in that they would have answered the survey questionnaire in the same way as if they had taken part. Furthermore, Welman *et al.* (2009) state that the reason for non-responses to occur is that participants refused to be involved in the research for various reasons, such as:

- Refusal to respond;
- Ineligibility to respond;
- Inability to locate participant; and
- Participant located, but unable to make contact.

Vosloo (2014) indicates that a low response rate limits the overview of the results from the questionnaires. Based on this perception that low response rates make the final sample smaller, to test the hypotheses, a number of steps may be considered to maximize the response rates. These include:

- Keep the questionnaires short and striking;
- Minimise cost and effort to the respondents;
- Promise (and provide) feedback to all the participants in the study;
- Provide a reward (book tokens, vouchers and the like) for completion of questionnaires; and
- Follow-up phone calls and visits to the respondents.

The response rate of 95% was achieved.

3.9 Reliability

As synonyms for reliability, Salkind (2006) used dependable, consistent, stable, trustworthy, predictable and faithful. According to Neuman and Kreuger (2003), perfect reliability is rare, but they suggested procedures to increase reliability of measures, as follows:

Increase the number of items or observations, i.e. the use of multiple indicators of a variable;

- Eliminate items that are unclear;
- Increase the level of measurement;
- Standardize the conditions under which the test is taken;
- Moderate the degree of difficulty of the instrument;
- Minimise the effects of external events;
- Standardise instructions;
- Maintain consistent scoring procedures; and
- Use pre-tests, pilot studies and replications.

A number of procedures exist for establishing the reliability of an instrument, such as test-retest method (Gratton and Jones, 2010). For this study a pilot study is conducted and the Cronbach's alpha co-efficient Cronbach alpha) is used to measure the reliability of the questionnaire.

3.9.1 The Cronbach alpha coefficient

According to Thietart, (2001) the Cronbach alpha coefficient is widely used as a reliable procedure to establish how well various items are positively correlated to one another. Guidelines to interpret Cronbach's alpha coefficient have been accepted by researchers (Vosloo, 2014):

- 0.90-high reliability;
- 0.80-moderate reliability;
- 0.70 - acceptable reliability;
- < 0.7 - low reliability.

This coefficient was used in the current study to test the correlation between various parameters chosen to conduct the study. The correlation between parameters is very important specially in this study where 13 entrepreneural core competencies were analysed.

3.9.2 Validity

Validity refers to the soundness of the interpretation of scores from a questionnaire (Vosloo, 2014). In the current study the internal validity of scaled responses is determined by the Cronbach's alpha co-efficient for validity.

3.10 Hypotheses testing

Testing of the hypotheses were done by using statistical tools such as, Exploratory Factor Analysis for the constructs, which included the mean, standard deviation, Cronbach's Alpha, factor loadings, Normality Test, Inter-constructs correlation Matrix as well as Regression analysis. The hypotheses testing will have to demonstrate whether or not there is a correlation between the constructs and how it contributed to enhance the core entrepreneurial competencies**.**

3.11 Summary

This chapter aimed to establish the approach to be used in order to verify the hypothesis and to achieve the objectives of the study. It is involving the survey population, area of the research where the study was conducted. Sampling design and procedures used in the study have also been covered. Variables and measurement procedures are explained as well as methods of data collection for the study and the methods which were used to process and analyse the data collected. The expected results of the study are also part of the chapter. The next chapter will focus entirely on data analysis.

CHAPTER 4: RESULTS AND DATA ANALYSIS

4.1 Demographic Information of Respondents

Table 4-1 shows the descriptive statistics of the respondents.

Table 4-1: Descriptive Statistics of the respondents

Profile of respondents (n=86)			**Number of years practicing** (n=83)		
Gender	**Frequency**	**Percentage**	Minimum	Maximum	Median
Male	75	87,2%	1	42	9
Female	11	12,8%			
Total	**86**	**100%**			

Most respondents had practiced as civil engineers for a median of 9 years, ranging from between 1 year to 42 years as shown in Table 4-1. Almost all the respondents (87,2%) were male. A small percentage (16,3%) of respondents had their own practices while 72% had considered setting up their own practices.

4.2 Conceptual Model

In order to empirically test the relationships between the study variables, a conceptual model was developed as shown in Figure 4-1 on the grounds of the literature review relating to the 13 core entrepreneurial competencies for a civil engineer to become a successful entrepreneur.

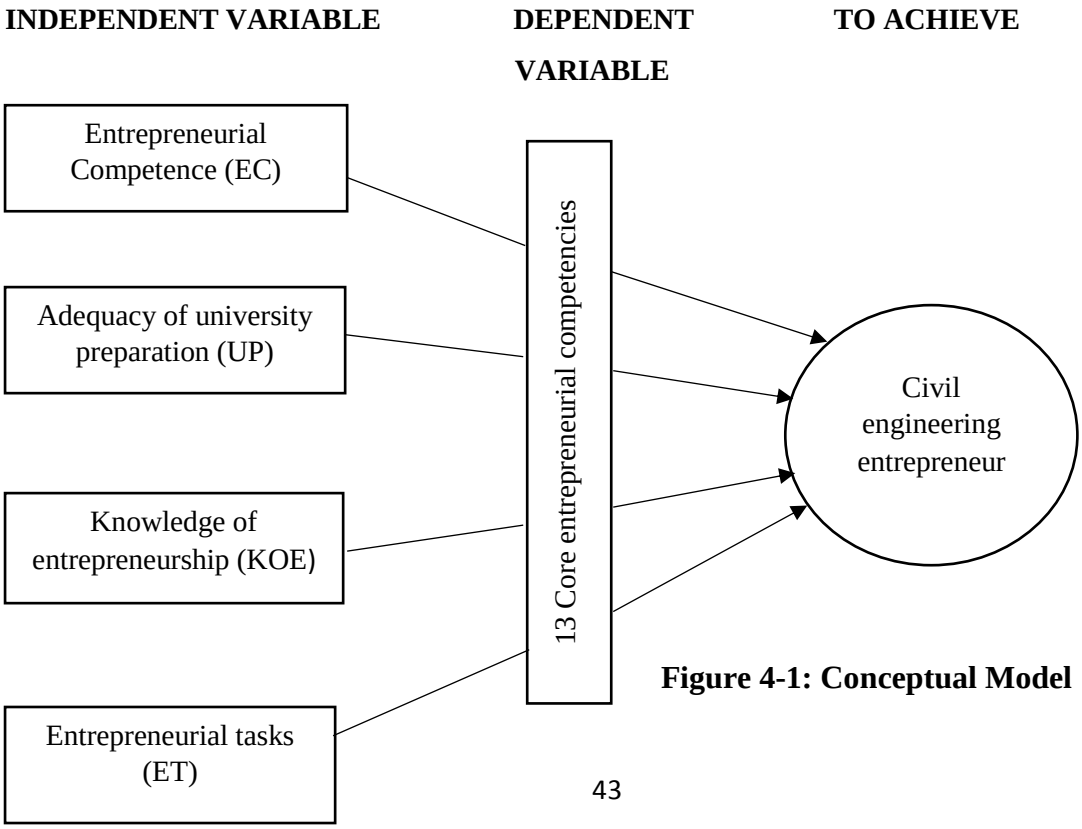

Figure 4-1: Conceptual Model

The model consists of five constructs: four independent variables and one dependent variable. Links between these constructs were examined to test the hypotheses for this study.

4.3 Reliability and Validity of Measurement Instrument

The measurement instrument for the constructs under study is shown in Table 4-2. The instrument was subjected to factor analysis with principle components extraction and Varimax with Kaiser Normalization rotation and using eigenvalues greater than 1. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was >0, 5 which indicates that the sample is sufficient for the five constructs. The factors explained >60% of the total variance.

Table 4-2: Categorization of scales

Mean Scale		
High	**Medium**	**Low**
>3.66	2.34 – 3.65	<2.33

The categorization of the means of the scaled responses is shown in Table 4-2 to assist with interpretation of the responses of participants.

After factor analysis, the resulting constructs were assessed for reliability and validity as shown in Table 4-3.

Table 4-3: Exploratory Factor Analysis (EFA)

Constructs	Description	Items	Mean	Standard Deviation	Scale	Ranking	Corrected Item to Total	Cronbach Alpha	CR value	AVE value	Factor Loadings
CORE ENTREPRENEURIAL COMPETENCIES (CEC) (n=83)	Opportunity Recognition	CEC1	4.0115	1.0398	High	10	0.419	0.774	0.857	0.329	0.540
	Opportunity Assessment	CEC2	4.1839	0.8698	High	6	0.523				0.486
	Risk Management/Mitigation	CEC3	4.3182	0.8516	High	2	0.347				0.391
	Conveying a compelling vision	CEC4	3.9091	0.9177	High	11	0.415				0.663
	Tenacity/Perseverance	CEC5	4.2159	0.8637	High	5	0.576				0.692
	Creative problem solving/imaginativeness	CEC6	4.2955	0.7605	High	3	0.431				0.548
	Resource leveraging	CEC7	3.6322	0.8229	Medium	12	0.480				0.477
	Guerrilla skills	CEC8	3.6706	1.1991	High	11	0.310				0.825
	Value creation	CEC9	4.1477	0.8649	High	7	0.300				0.348
	Maintain focus yet adapt	CEC10	4.0345	0.8552	High	8	0.416				0.563
	Resilience	CEC11	4.2159	0.8637	High	4	0.530				0.755
	Self-efficacy	CEC12	4.2955	0.8327	High	3	0.624				0.533
	Building and using networks	CEC13	4.3409	0.8149	High	1	0.364				0.421
ENTREPRENEURIAL COMPETENCE (EC) (n=83)	I often make novel connections and perceive new relationships between various pieces of information	EC1	3.4432	0.9692	Medium	8	0.301	0.651	0.945	0.561	0.799
	I can distinguish between profitable opportunities and not so profitable opportunities	EC2	3.8182	0.9535	High	5	0.350				0.838
	When facing multiple opportunities I am able to select the good ones	EC3	3.8372	0.6836	High	4	0.355				0.700
	I am more of a risk avoider than a risk manager	EC4	3.0227	1.2127	Medium	12	0.380				0.749

Table 4-3 cont'd: Exploratory Factor Analysis (EFA)

Constructs	Description	Items	Mean	Standard Deviation	Scale	Ranking	Corrected Item to Total	Cronbach Alpha	CR value	AVE value	Factor Loadings
ENTREPRENEURIAL COMPETENCE (EC) (n=83)	I find it difficult to get others committed to my vision or dreams	EC5	2.7273	1.1216	Medium	13	0.381	0.651	0.945	0.561	0.835
	I often set a goal but later choose to pursue a different one	EC6	2.2727	1.0692	Low	14	0.368				0.546
	I am creative when asked to work with limited resources	EC7	3.9205	0.9374	High	2	0.431				0.576
	There is always a way to obtain a resource even if you cannot afford it	EC8	3.7045	1.0075	High	6	0.384				0.908
	I could quickly identify three guerrilla ideas to help a start-up venture	EC9	3.1818	1.1798	Medium	10	0.349				0.740
	New business ideas often come to me when directly observing how people interact with products and services	EC10	3.6477	1.2038	Medium	7	0.546				0.822
	I tend to look for the right answer, rather than realize there might be multiple ways to get to an end result	EC11	3.0568	1.1681	Medium	11	0.374				0.812
	I believe that I can grow in positive ways by dealing with difficult situations	EC12	4.4318	0.7078	High	1	0.491				0.749
	I can shape whatever environment in which I find myself operating	EC13	3.8837	0.9383	High	3	0.369				0.414

Table 4-3 cont'd: Exploratory Factor Analysis (EFA)

Constructs	Description	Items	Mean	Standard Deviation	Scale	Ranking	Corrected Item to Total	Cronbach Alpha	CR value	AVE value	Factor Loadings
EC	I often attend social functions for purposes of building professional relationships	EC14	3.4253	1.2069	Medium	9	0.416	0.651	0.945	0.561	0.834
UNIVERSITY PREPARATION FOR BEING ENTREPRENEURS (UP) (n=87)	The University modules/offerings/classes I attended increased my understanding of the attitudes, values and motivations of entrepreneurs	UP1	2.5682	1.3713	Medium	2	0.835	0.930	0.932	0.669	0.936
	The University modules/offerings/classes I attended increased my understanding of the actions someone has to take in order to start a business	UP2	2.3218	1.2713	Low	6	0.882				0.918
	The University modules/offerings/classes I attended enhanced my practical management skills in order to start a business	UP3	2.3864	1.2358	Medium	4	0.898				0.874
	The University modules/offerings/classes I attended enhanced my ability to develop networks	UP4	2.4886	1.2034	Medium	3	0.835				0.869

Table 4-3 cont'd: Exploratory Factor Analysis (EFA)

Constructs	Description	Items	Mean	Standard Deviation	Scale	Ranking	Corrected Item to Total	Cronbach Alpha	CR value	AVE value	Factor Loadings
UNIVERSITY PREPARATION FOR BEING ENTREPRENEURS (UP) (n=87)	The University modules/offerings/classes I attended enhanced my ability to identify an opportunity	UP5	2.5909	1.1309	Medium	1	0.818	0.930	0.932	0.669	0.853
	There was a favourable climate and premises for becoming an entrepreneur at my university	UP6	1.9659	1.0108	Low	7	0.600				0.611
	At my university I found many entrepreneurial-minded classmates	UP7	2.3523	1.0509	Medium	5	0.575				0.587
KNOWLEDGE OF ENTREPRENEURSHIP (KOE) (n=75)	Characteristics of entrepreneurs	KOE1	3.2841	1.1442	Medium	16	0.510	0.944	0.962	0.418	0.790
	Role of entrepreneurs in the world economy	KOE2	3.7273	0.8935	High	7	0.453				0.601
	Business ethics	KOE3	3.875	0.9446	High	6	0.457				0.572
	Risk management	KOE4	3.5795	0.9312	Medium	10	0.535				0.733
	Legal structures for ventures (forms of business entities)	KOE5	2.7442	1.1081	Medium	32	0.469				0.605
	Intrapreneurship	KOE6	2.8372	1.2258	Medium	30	0.262				0.449
	Social entrepreneurship	KOE7	2.954	1.1092	Medium	28	0.458				0.621
	Leadership	KOE8	4.1932	0.6038	High	1	0.542				0.698
	Managing teams	KOE9	4.125	0.7081	High	3	0.394				0.569
	Project management	KOE10	4.1818	0.6872	High	2	0.428				0.627
	Negotiation	KOE11	3.9432	0.8625	High	5	0.460				0.699
	Product development	KOE12	3.2614	1.088	Medium	17	0.280				0.669
	Product lifecycle	KOE13	3.4886	0.9825	Medium	12	0.422				0.439
	Economies of scale	KOE14	3.0575	1.1549	Medium	23	0.564				0.671

Table 4-3 cont'd: Exploratory Factor Analysis (EFA)

Constructs	Description	Items	Mean	Standard Deviation	Scale	Ranking	Corrected Item to Total	Cronbach Alpha	CR value	AVE value	Factor Loadings
KNOWLEDGE OF ENTREPRENEURSHIP (KOE) (n=75)	Feasibility study	KOE15	3.9773	0.9823	High	4	0.459	0.944	0.962	0.418	0.616
	Prototype	KOE16	3.1034	1.2011	Medium	22	0.250				0.850
	Intellectual property	KOE17	3.4886	0.9942	Medium	12	0.440				0.616
	Technology commercialization	KOE18	3.0455	1.0273	Medium	25	0.534				0.810
	Patents	KOE19	2.9545	1.2026	Medium	27	0.555				0.585
	Finance and accounting	KOE20	3.0000	1.1646	Medium	26	0.527				0.610
	Venture capital	KOE21	2.593	1.0887	Medium	33	0.548				0.809
	Equity	KOE22	3.1136	1.1689	Medium	21	0.710				0.568
	Company valuation	KOE23	2.9432	1.1281	Medium	29	0.545				0.554
	Balance sheet	KOE24	3.0568	1.2536	Medium	24	0.691				0.738
	Break even	KOE25	3.2471	1.2993	Medium	19	0.655				0.668
	Income statement	KOE26	3.4545	1.1538	Medium	12	0.678				0.644
	Market research	KOE27	3.375	1.0966	Medium	15	0.650				0.645
	Competitive analysis	KOE28	3.1786	1.2337	Medium	20	0.700				0.652
	Target market	KOE29	3.5909	1.141	Medium	9	0.674				0.453
	Product positioning	KOE30	2.8023	1.1253	Medium	31	0.625				0.593
	Product distribution	KOE31	3.0455	1.0495	Medium	25	0.762				0.438
	Advertising and promotion	KOE32	3.4091	1.1000	Medium	14	0.602				0.504
	Sales and selling	KOE33	3.1136	1.159	Medium	21	0.728				0.640
	Executive summary	KOE34	3.5114	1.1938	Medium	11	0.659				0.681
	Business plan	KOE35	3.625	0.9627	Medium	8	0.622				0.726
	Business models	KOE36	3.2500	0.9377	Medium	18	0.676				0.704
	Business incubator	KOE37	2.2907	1.0613	Low	34	0.579				0.593

Table 4-3 cont'd: Exploratory Factor Analysis (EFA)

Constructs	Description	Items	Mean	Standard Deviation	Scale	Ranking	Corrected Item to Total	Cronbach Alpha	CR value	AVE value	Factor Loadings
ABILITY TO PERFORM ENTREPRENEURIAL TASK (ET) (n=80)	Know the steps needed to place a financial value on a new business venture	ET1	2.6512	1.1143	Medium	14	0.662	0.891	0.946	0.543	0.681
	Pick the right marketing approach for the introduction of a new service	ET2	2.686	0.9972	Medium	13	0.711				0.605
	Work with a supplier to get better prices to help a venture become successful	ET3	3.3256	0.9875	Medium	9	0.669				0.665
	Estimate accurately the costs of running a new project	ET4	3.8313	0.9604	High	1	0.489				0.844
	Recognize when an idea is good enough to support a major business venture	ET5	3.3647	1.0673	Medium	8	0.595				0.828
	Recruit the right employees for a new project or venture	ET6	3.5238	1.1137	Medium	4	0.532				0.549
	Convince a customer or client to try a new product for the first time	ET7	2.9535	1.0279	Medium	12	0.560				0.719
	Write a clear and complete business plan	ET8	2.9535	1.1157	Medium	12	0.674				0.729
	Convert a useful scientific advance into a practical application	ET9	3.0581	1.0444	Medium	10	0.498				0.772

Table 4-3 cont'd: Exploratory Factor Analysis (EFA)

Constructs	Description	Items	Mean	Standard Deviation	Scale	Ranking	Corrected Item to Total	Cronbach Alpha	CR value	AVE value	Factor Loadings
ABILITY TO PERFORM ENTREPRENEURIAL TASK (ET) (n=80)	Develop your own original hypothesis and a research plan to test it	ET10	3.0465	1.1157	Medium	11	0.541	0.891	0.946	0.543	0.761
	Grasp the concept and limits of a technology well enough to see the best ways to use it	ET11	3.407	0.8994	Medium	7	0.435				0.688
	Design and build something new that performs very close to your design specifications	ET12	3.7412	0.9899	High	2	0.485				0.723
	Understand exactly what is new and important in a ground-breaking theoretical article	ET13	3.4235	0.8504	Medium	6	0.486				0.803
	Lead a technical team developing a new product to a successful result	ET14	3.5059	0.8947	Medium	5	0.572				0.801
	Translate user needs into requirements for a design so well that users will like the outcome	ET15	3.5882	1.0035	Medium	3	0.478				0.817

The results of the measurement model as well as the results for reliability checks (the Cronbach alpha and the Composite Reliability (CR) values) and the validity checks (AVE values), are presented in Table 4-3. The factor loadings are also displayed. Evidence of internal consistency is shown by the coefficient of Cronbach's alpha and the composite reliability values. The Cronbach's alpha values ranged between 0.651 and 0.944 and as a result four of the study constructs exceeded the threshold of 0.70 for acceptable internal scale consistency, except for entrepreneurial competence which is marginally lower (0.651) as recommended by Byrne (2013). All constructs had a CR value (using a composite reliability (C.R.) calculator according to Colwell (2016) that measured well above 0.7, which means that all constructs exceeded the threshold recommended by Hulland (1999). Therefore all constructs have an acceptable reliability value.

The values for average variance extracted (AVE), which examines the amount of variance that is taken into account by the construct's measure in relation to the measurement error and also links between the unobserved constructs within the model (Fornell and Larcker, 1981). They estimated that AVE values of >0.5 showed that the construct is a valid measure. All constructs met this requirement except for two that have marginally lower values of 0.329 and 0.418.

The rotated factor loadings, which is the correlation between a variable and a factor where only a single factor is involved, were significant at >0.4 as a rule of thumb to be considered important. However, only one factor was marginally lower at 0,391, which means that the factor loadings were significant. All the item-to-total variables under study were above the threshold of 0.30 as recommended by Cristobal et al. (2007), except for three which were marginally lower at 0.280 (product development), 0.262 (intrapreneurship) and 0.250 (prototype). According to Churchill (1979) a correlation value of less than 0.2 indicates that the corresponding item does not correlate well with the scale and it may be dropped, but as these three variable do contribute to the purpose of this study, it should remain and therefore the variables were regarded as acceptable.

From the analysis of Table 4-3 the constructs are described as follows:

4.3.1 Core entrepreneurial competencies

In regards with this construct there were high levels of agreement by respondents with 12 out of 13 (92.3%) core entrepreneurial competencies to become a successful civil engineering entrepreneur, with means > 3.66. These include (ranking in descending order):

- ☐ Building and using networks (m = 4.3409);
- ☐ Risk Management/Mitigation (m = 4.3182) ;
- ☐ Creative problem solving/imaginativeness (m = 4.2955);
- ☐ Self-efficacy (m = 4.2955);
- ☐ Resilience (m = 4.2614);
- ☐ Tenacity/Perseverance (m = 4.2159);
- ☐ Opportunity Assessment (m = 4.1839);
- ☐ Value creation (m = 4.1477);
- ☐ Maintain focus yet adapt (m = 4.0345);
- ☐ Opportunity Recognition (m = 4.0115);
- ☐ Conveying a compelling vision (m = 3.9091);
- ☐ Guerilla skills (m = 3.6706).

And a medium level of agreement for one competency, with a mean of between 2.34 and 3.65, which is:

- ☐ Resource leveraging (m = 3.6322).

These results bear evidence that the practicing civil engineers clearly understood the importance of the 13 core competencies to be successful as entrepreneurs.

4.3.2 Entrepreneurial competence

There were six out of the fourteen statements (42.9%) where the respondents reported high levels of agreement that entrepreneurial competence is necessary for entrepreneurial action, with means of > 3.66. This include in descending order:

- ☐ I believe that I can grow in positive ways by dealing with difficult situations (m = 4.4318);
- ☐ I am creative when asked to work with limited resources (m = 3.9205);

- ☐ I can shape whatever environment in which I find myself operating (m = 3.8837);
- ☐ When facing multiple opportunities I am able to select the good ones (m = 3.8372);
- ☐ I can distinguish between profitable opportunities and not so profitable opportunities (m = 3.8182);
- ☐ There is always a way to obtain a resource even if you cannot afford it (m = 3.7045).

Seven statements (50%) had a medium level of agreement with means of between 2.34 and 3.65, which include in descending order:

- ☐ New business ideas often come to me when directly observing how people interact with products and services (m =3.6477);
- ☐ I often make novel connections and perceive new relationships between various pieces of information (m = 3.4432);
- ☐ I often attend social functions for purposes of building professional relationships (m = 3.4253);
- ☐ I could quickly identify three guerilla ideas to help a start-up venture (m = 3.1818);
- ☐ I tend to look for the right answer, rather than realize there might be multiple ways to get to an end result (m = 3.0568);
- ☐ I am more of a risk avoider than a risk manager (m = 3.0227);
- ☐ I find it difficult to get others committed to my vision or dreams (m = 2.7273).

One out of the fourteen with a low level of agreement, with a mean > 2.33., which include:

- ☐ I often set a goal but later choose to pursue a different one (m = 2.2727).

These results indicate that the practicing civil engineers are able to work under difficult conditions, but do not having the competence driven by entrepreneurship to manage a company as an entrepreneur although civil engineers do understand the importance to pursue their dreams and visions.

4.3.3 University preparation

There were five out of the seven statements (71.4%) where respondents indicated a medium level of agreement with means between 2.34 and 3.65 that there was adequate university preparation for entrepreneurship in civil engineering, which include:

- The University modules/offerings/classes I attended enhanced my ability to identify an opportunity (m = 2.5909);
- The University modules/offerings/classes I attended increased my understanding of the attitudes, values and motivations of entrepreneurs (m = 2.5682);
- The University modules/offerings/classes I attended enhanced my ability to develop networks (m = 2.4886).
- The University modules/offerings/classes I attended enhanced my practical management skills in order to start a business (m = 2.3864);
- At my university I found many entrepreneurial-minded classmates (m = 2.3523);
- The University modules/offerings/classes I attended increased my understanding of the actions someone has to take in order to start a business (m = 2.3218);
- There was a favorable climate and premises for becoming an entrepreneur at my university (m = 1.9659).

There was to a degree some awareness of entrepreneurship in the modules offered at universities, but inadequate preparation for developing of civil engineers to become entrepreneurs. Respondents are convinced that the universities did not play a major role to interest them in entrepreneurship.

4.3.4 Knowledge of entrepreneurship

There were seven out of the thirty-seven knowledge areas of entrepreneurship (18.9%), where the respondents show a high level of understanding, with means >3.66, which include (in descending order):

- Leadership (m = 4.1932):
- Project management (m = 4.1818);
- Managing teams (m = 4.1250);
- Feasibility study (m = 3.9773);
- Negotiation (m = 3.9432);
- Business ethics (m = 3.8750);
- Role of entrepreneurs in the world economy (m = 3.7273);

Twenty-nine out of the thirty-seven (78.4%) show medium levels with means between 2.34 and 3.65, which include:

- Business plan (m = 3.6250);
- Target market (m = 3.5909);
- Risk management (m = 3.5795);
- Executive summary (m = 3.5114);
- Product lifecycle (m = 3.4886);
- Intellectual property (m = 3.4886);
- Income statement (m = 3.4545);
- Advertising and promotion (m = 3.4091);
- Market research (m = 3.3750);
- Characteristics of entrepreneurs (m = 3.2841);
- Product development (m = 3.2614);
- Business models (m = 3.2500);
- Break-even (m = 3.2471);
- Competitive analysis (m = 3.1786);
- Equity (m = 3.1136);
- Sales and selling (m = 3.1136);
- Prototype (m = 3.1034);

- Economies of scale (m = 3.0575);
- Balance sheet (m = 3.0568);
- Technology commercialization (m = 3.0455);
- Product distribution (m = 3.0455);
- Finance and accounting (m = 3.0000);
- Patents (m = 2.9545);
- Social entrepreneurship (m = 2.9540);
- Company valuation (m = 2.9432);
- Intrapreneurship (m = 2.8372);
- Product positioning (m = 2.8023);
- Legal structures for ventures (forms of business entities) (m = 2.7442);
- Venture capital (m = 2.5930).

One respondents reported a low level of understanding with a mean < 2.33 of the knowledge of entrepreneurship namely:

- Business incubator (m = 2.2907).

These results indicate that the respondents have developed certain knowledge areas about entrepreneurship, but when confronted with the broader knowledge of entrepreneurship it is clear that the knowledge areas diminish and it shows that intervention is required for civil engineers to understand entrepreneurship. However, civil engineers do understand how to manage teams with their leadership skills;

4.3.5 Entrepreneurial tasks

There were two out of fifteen statements (13.3%) where the respondents show a high level of confidence in the ability to perform entrepreneurial tasks with means > 3.66, which include:

- Estimate accurately the costs of running a new project (m = 3.8313);
- Design and build something new that performs very close to your design specifications (m = 3.7412).

The remaining statements show a medium level of understanding, with means between 2.34 and 3.65, which include:

- ☐ Translate user needs into requirements for a design so well that users will like the outcome (m = 3.5882);
- ☐ Recruit the right employees for a new project or venture (m = 3.5238);
- ☐ Lead a technical team developing a new product to a successful result (m = 3.5059);
- ☐ Understand exactly what is new and important in a groundbreaking theoretical article (m =3.4235);
- ☐ Grasp the concept and limits of a technology well enough to see the best ways to use it (m = 3.407);
- ☐ Recognize when an idea is good enough to support a major business venture (m = 3.3647);
- ☐ Work with a supplier to get better prices to help a venture become successful (m = 3.3256);
- ☐ Convert a useful scientific advance into a practical application (m = 3.0581);
- ☐ Develop your own original hypothesis and a research plan to test it (m = 3.0465);
- ☐ Convince a customer or client to try a new product for the first time (m = 2.9535);
- ☐ Write a clear and complete business plan (m = 2.9535);
- ☐ Pick the right marketing approach for the introduction of a new service (m = 2.6860);
- ☐ Know the steps needed to place a financial value on a new business venture (m = 2.6512).

These results show that civil engineers have the ability to understand and perform their duties on a project, but when it comes to tasks that are required by an entrepreneur, there is certainly a lesser amount of confidence to perform entrepreneurial tasks, which could be overcome by training.

4.4 Normality Test

Table 4-4: Tests of Normality

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
CEC	0.127	86	0.002	0.850	86	0.000
EC	0.103	86	0.025	0.979	86	0.169
UP	0.121	86	0.003	0.946	86	0.001
KOE	0.113	86	0.009	0.968	86	0.031
ET	0.101	86	0.031	0.961	86	0.011

a. Lilliefors Significance Correction

The normality test results shown in Table 4-4, with specific reference to Shapiro Wilk reveal that all the measured scales except for one do not come from a normal distribution with p-values of all, except one of the variables being significant ($p<0.05$). This implies that all bivariate relationships will be assessed by Spearman Rank Correlation, which is a non-parametric test.

4.5 Inter-constructs correlation Matrix

Correlation of the summated scales was used to assess construct discriminant validity. The correlations are shown in Table 4-5.

Table 4-5: Correlation between Constructs

CONSTRUCTS		CEC	EC	UP	KOE	ET
Spearman's rho	**CEC**	1.000				
	EC	0.393**	1.000			
	UP	0.156	0.214*	1.000		
	KOE	0.479**	0.307**	0.224*	1.000	
	ET	0.062	0.349**	0.367**	0.472**	1.000

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

All the inter-construct correlations were < 0.80 indicating a good general discriminant validity as values above 0.8 may suggest there is a multi-collinearity between constructs as specified by

Hulland (1999) and therefore deemed acceptable, because no two constructs are too strongly correlated and so each depicts a different concept.

Core entrepeneurial competencies were significantly positively correlated with entrepreneurial competence ($r = 0.393$, $p < 0.05$) and knowledge of entrepreneurship ($r = 0.479$, $p < 0.05$). University preparation ($r = 0.156$, $p > 0.05$), and ability to perform entrepreneurial tasks ($r = 0.062$, $p > 0.05$), on the other hand, had no significant relationship with core entrepreneurial competencies.

4.6 Regression Analysis

The measuring instrument has been assessed for its reliability and validity, normality test performed to assess whether the bivariate relationship needed to be assessed with parametric or non-parametric tests, relationships among the independent variables have been evaluated for no evidence of interdependence ($r > 0.8$), relationships among the variables have also been tested to determine which independent variables individually associates with the dependent variable (core entrepreneurial competencies).

The conceptual model was evaluated by jointly testing the association of the independent variables on the dependent variable. To achieve the desired outcome regression was performed with the Core Entrepreneurial Competencies on the four independent variables, Entrepreneurial Competence (EC), Knowledge of Entrepreneurship (KOE), University Preparation for Entrepreneurship (UP), and ability to perform Entrepreneurial Tasks (ET). Results of the regression are shown in Tables 4-6 to 4-8.

Table 4-6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.574[a]	0.329	0.296	0.46251

a. Predictors: (Constant), ET, UP, EC, KOE

Table 4-7: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	**Regression**	8.493	4	2.123	9.925	0.000[b]
	Residual	17.327	81	0.214		
	Total	25.819	85			

a. Dependent Variable: CEC

b. Predictors: (Constant), ET, UP, EC, KOE

Table 4-8: Coefficients

Model		Unstandardized Coefficients		t	Sig.
		B	Std. Error		
1	**(Constant)**	1.805	0.433	4.165	0.000
	EC	0.551	0.124	4.453	0.000
	UP	-0.011	0.055	-0.208	0.836
	KOE	0.392	0.106	3.691	0.000
	ET	-0.272	0.105	-2.603	0.011

a. Dependent Variable: CEC

Multiple linear regression model was done with four independent variables being entered in to the model. Tables 4-6 to 4-8 shows that the model was able to explain 29.6% of the variation in the dependent variable (adjusted $R^2 = 0.296$) which was found to significantly predict the dependent variable, ($F(4, 81) = 9.925$, $p < 0.05$). Three of the independent variables significantly contributed to the model. Holding the effect of other variables constant, Entrepreneurial Competence ($b = 0.551$, $p < 0.05$) and Knowledge of entrepreneurship ($b = 0.392$, $p < 0.05$) were significantly associated with increased core entrepreneurial competencies, while ability to perform Entrepreneurial Tasks ($b = -0.272$, $p < 0.05$) was significantly associated with decreased or lower core entrepreneurial competencies. University Preparation for Entrepreneurship, on the other hand did not significantly contribute to core entrepreneurial competencies ($b = -0.011$, $p > 0.05$).

4.7 Summary

This chapter focused on the conceptual model involving dependent and independent variables. Statistical tools such as SPSS v24 were used to analyse the generated data from the 13 core comptencies (CEC) and the 4 constructs (EC, UP, KOE and ET). The analysis of these various parameters, such as the core competencies and contructs, has indicated that there is correlation between all the constructs. Yet, it also shows that UP and ET were not statistically significant.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

There are competencies that are unique to the civil engineering discipline and it is necessary that education programmes need to construct curriculums that support the entrepreneurial endeavours of graduates. When the literature was reviewed, it was clear that core competencies, traits and the environment has an influence on an entrepreneur to be successful. Therefore, it is important to train civil engineers, with the aim to equip and empower graduates with the necessary tools to become entrepreneurs. Empowerment must be combined with entrepreneurial skills to produce professional entrepreneurs. Civil engineering entrepreuneurship is a field that has not yet been widely developed by tertiary institutions in South Africa and most possibly globally. It is a mutlti-disciplinary field that requires highly skilled and well trained people who can teach the relevant knowledge to young graduates who are willing to become successful civil engineering entrepreneurs.

This study identified those competencies that are necessary for civil engineers to be successful as entrepreneurs, an aspect of their education and training that has been ignored. The findings provide guidance for the development of curriculums that are responsive to the development of these core competencies in civil engineering graduates.

5.2 Problem statement

The problem statement for the study was:

The substantial lack of civil engineering entrepreneurial skills coupled with the absence of entrepreneurial civil engineering training combined with a non-conducive environment prevent civil engineering graduates to become successful entrepreneurs.

5.3 Hypotheses

The hypotheses to be tested in this study were:

- **Hypothesis 1:** The entrepreneurial competence of civil engineering graduates impacts the ability of the graduates to become successful entrepreneurs through increased core entrepreneurial competencies.
- **Hypothesis 2:** Inadequate university preparation impacts negatively to core entrepreneurial competencies for civil engineers to become successful entrepreneurs.
- **Hypothesis 3:** Knowledge of entrepreneurship improves with increased core entrepreneurial competencies.
- **Hypothesis 4:** Entrepreneurial tasks performed by civil engineers lower with increased core entrepreneurial competencies.

5.4 Objectives

- To analyse the entrepreneurial competence of practicing civil engineering graduates.
- To explore the impact of university preparation for civil engineering graduates in terms of core entrepreneurial competencies.
- To determine the knowledge that civil engineering graduates have of entrepreneurship.
- To analyse the entrepreneurial tasks that civil engineers perform in relationship with core entrepreneurial competencies.

The research objectives were fulfilled from an established methodological approach that generated data followed by statistical analyses that involved various correlations between the constructs and its contribution on the core entrepreneurial competencies. Hypotheses testing were then used to establish these correlations to draw the relevant conclusions.

5.5 Hypotheses testing:

Hyphothesis 1: The entrepreneurial competence of civil engineering graduates impacts the ability of the graduates to become successful entrepreneurs through increased core entrepreneurial competencies.

Evidence from the study showed that core entrepeneurial competencies were significantly positively associated with increased core entrepreneurial competencies.

Literature revealed that only when entrepreneurship is seen as a desirable discipline will the necessary competence be sought after by graduates.

Therefore, the hypothesis that entrepreurial competence impacts civil engineering graduates to become entrepreneurs throug increased core entrepreneurial competencies cannot be rejected.

Hypothesis 2: Inadequate university preparation impacts negatively on core entrepreneurial competencies for civil engineers to become successful entrepreneurs.

Evidence from the study showed that university preparation had no significant relationship and did not significantly contribute to core entrepreneurial competencies. This finding is not surprising because to date university engineering curriculums do not address entrepreneurial competences as requirements for graduation from their engineering programmes. Therefore their impact on preparing graduates to be entrepreneurs once they enter the world of work after leaving the university is limited if any.

Literature revealed that there is a positive correlation between entrepreneurship education and the number of graduates who eventually become entrepreneurs instead of job-seekers. Arguably, in the absence of entrepreneurship education which is the current status, graduates from universities will be poorly prepared for the real world of work and professional practice. Entrepreneurship education can lead to increased entrepreneurial intentions of students.

Therefore, the hypothesis that inadequate university preparation impacts negatively on core entrepreneurial competencies for civil engineers to become successful entrepreneurs cannot be rejected.

Hypothesis 3: Knowledge of entrepreneurship improves with increased core entrepreneurial competencies.

Evidence from the study showed that knowledge of entrepreneurship was significantly positively associated with increased core entrepreneurial competencies and with the use of a linear regression model it was also found that a positive correlation existed between the knowledge of entrepreuneurship and the core entrepreneurial competencies. This implies that if an individual is well informed and properly trained in order to become a successful entrepreneur, the higher is the possibility to develop that individual's entrepreneurial competencies.

Literature revealed that several aspects of entrepreneurship programmes, including disciplinary focus, participation in experiential learning, and number of courses, impact student perceptions of their entrepreneurial knowledge and self-efficacy (Duval-Couetil et al, 2016; Duval-Couetil 2013; Günzel-Jensen et al., 2017).

Therefore, the hypothesis that knowledge of entrepreneurship improves with increased core entrepreneur competencies cannot be rejected.

Hypothesis 4: Entrepreneurial tasks performed by civil engineers depend on their core entrepreneurial competencies.

Evidence from the study showed that the ability to perform entrepreneurial tasks had no significant relationship with core entrepreneurial compentencies and therefore was associated with decreased core entrepreneurial competencies. This is supported by linear regression analysis using a model which revealed that the ability to perform entrepreneurial tasks was significantly associated with decreased or lower core entrepreneurial competencies. This could mean that to perform entrepreneurial tasks is probably related to an individual's attitude, commitment and motivation.

Similar studies, from literature, have revealed that when the entrepreneur takes on many and varied roles, the success of the venture can depend on the entrepreneur's ability to find a balance between different tasks. When placed in the context that centres on experiencing and

performing real tasks that support entrepreneurial outcomes, respondents may appear to demonstrate some competencies (Shepherd and Patzelt, 2017; Markman et al., 2016; Kuratko, 2015). Comparing the outcomes from previous studies with that of this current study, the ability to perform a tasks as an entrepreneur is therefore closely related to core entrepreneurial competences.

Therefore, the hypothesis that entrepreneurial tasks performed by civil engineers depend on their core entrepreneurial competencies cannot be rejected.

5.6 Conclusions

The main findings in this study revealed that civil engineers:

- Do understand that the 13 core entrepreneurial competencies are important to be successful entrepreneurs;
- Do understand the importance to work under difficult situations to pursue their dreams and visions;
- That graduates at universities are convinced that the universities they attended did not play a major role to interest them in entrepreneurship;
- Do understand how to manage teams with their leadership skills;
- Are confident to estimate costs, design and build new structures.
- The respondents have some knowledge about entrepreneurship in terms of principles, but they do not have the ability to apply it. This confirms the fact that entrepreneurial competence and knowledge of entrepreneurship were significant.

Similar conclusions were also found in studies done by Duval-Couetil, et al. (2016). They found that the movement to incorporate engineering education with more entrepreneurial knowledge and skills is increasing. This is driven by a belief that training engineers with a range of skills will assist them to create value in a new economy. Programme models to deliver entrepreneurship education to engineering students can vary greatly based on the degree to which they are engineering-based or interdisciplinary and the type and number of courses and activities they encompass. It is important that engineering programmes deliver the type and quantity of engineering education and activities that will have the most impact,

given the challenges associated with adding a new curriculum for engineering students who typically have very full academic programmes.

5.8 Recommendations for future/further studies

Overall, it is clear from the findings of this study that civil engineers lack the basic skills to run their own businesses and therefore further studies are required to identify those unique competencies necessary for civil engineers to be successful as professionals. As a result the civil engineering discipline education programmes need to develop curricula that support the entrepreneurial endeavours of civil engineering graduates, an aspect of their education and training that has to date been largely ignored.

Further research should analyse the specific knowledge, skills and behaviours associated with experiential learning activities in entrepreneurship to arrive at a better understanding of the manner in which they impact competency, self-efficacy, and intention to be an entrepreneur. Developers of engineering education must consider factors such as the extend, the type and how much entrepreneurship education do engineering graduates need when they develop entrepreneurship curricula targeting engineers.

Progress in identifying, defining and measuring key competencies has valuable implications for both the advancement of entrepreneurship education and improving entrepreneurial practice. Competencies directly correlate with job performance can be improved with training. A further possibility is that Government should provided a conducive environment and enough opportunities for entrepreneurship training. Therefore, it is expected that the government should be in the forefront in promoting entrepreneurship in engineering to boost the economy of South Africa.

Further studies should be done on curriculum development for entrepreneurial training for engineering in general and for civil engineering specifically. This curriculum will enhance the ability for civil engineering to become successful entrepreneurs. The 13 core entrepreneurial competencies established in this current study can be used to develop the

curriculum content for such a curriculum. Therefore, the constructs used in this current study can also add value to future studies involving curriculum development.

ANNEXURE 1: QUESTIONNAIRE

1. Please indicate how important each of the following entrepreneurial competencies are to be a successful professional civil engineer with 1 = not important at all and 5 = extremely/critically important:

No	Core Entrepreneurial Competencies	1	2	3	4	5
1	Opportunity Recognition: the capacity to perceive changed conditions or overlooked possibilities in the environment that represent potential sources of profit or return to a venture					
2	Opportunity Assessment: ability to evaluate the content structure of opportunities to accurate determine their relative attractiveness					
3	Risk Management/Mitigation: the taking of actions that reduce the probability of a risk occurring or reduce the potential impact if the risk were to occur					
4	Conveying a compelling vision: the ability to conceive an image of a future organizational state and to articulate that image in a manner that empowers followers to enact it					
5	Tenacity/Perseverance: ability to sustain goal-directed action and energy when confronting difficulties and obstacles that impede goal achievement					
6	Creative problem solving/imaginativeness: the ability to relate previously unrelated objects or variables to produce novel and appropriate or useful outcomes					
7	Resource leveraging: skills at accessing resources one does not necessarily own or control to accomplish personal ends					
8	Guerilla skills: the capacity to take advantage of one's surroundings, employ unconventional, low cost tactics not recognized by others, and do more with less					
9	Value creation: capabilities of developing new products, services, and/or business models that generate revenues exceeding their costs and produce sufficient user benefits to bring about a fair return					
10	Maintain focus yet adapt: ability to balance an emphasis on goal achievement and the strategic direction of the organization while addressing the need to identify and pursue actions to improve the fit between an organization and developments in the external environment					

11	Resilience: ability to cope with stresses and disturbances such that one remains well, recovers, or event thrives in the face of adversity					
12	Self-efficacy: ability to maintain a sense of self-confidence regarding one's ability to accomplish a particular task or attain a level of performance					
13	Building and using networks: social interaction skills that enable an individual to establish, develop, and maintain sets of relationships with others who assist them in advancing their work or career					

2. Please indicate to what extent you agree with the following statements with 1 = totally disagree and 5 = totally agree:

No	Entrepreneurial Competence	1	2	3	4	5
1	I often make novel connections and perceive new relationships between various pieces of information					
2	I can distinguish between profitable opportunities and not so profitable opportunities					
3	When facing multiple opportunities I am able to select the good ones					
4	I am more of a risk avoider than a risk manager					
5	I find it difficult to get others committed to my vision or dreams					
6	I often set a goal but later choose to pursue a different one					
7	I am creative when asked to work with limited resources					
8	There is always a way to obtain a resource even if you cannot afford it					
9	I could quickly identify three guerilla ideas to help a start-up venture					
10	New business ideas often come to me when directly observing how people interact with products and services					
11	I tend to look for the right answer, rather than realize there might be multiple ways to get to an end result					
12	I believe that I can grow in positive ways by dealing with difficult situations					
13	I can shape whatever environment in which I find myself operating					
14	I often attend social functions for purposes of building professional relationships					

3. Please indicate to what extent you agree with the following statements with 1 = totally disagree and 5 = totally agree:

No	Adequacy of University Preparation	1	2	3	4	5
1	The University modules/offerings/classes I attended increased my understanding of the attitudes, values and motivations of entrepreneurs					
2	The University modules/offerings/classes I attended increased my understanding of the actions someone has to take in order to start a business					
3	The University modules/offerings/classes I attended enhanced my practical management skills in order to start a business					
4	The University modules/offerings/classes I attended enhanced my ability to develop networks					
5	The University modules/offerings/classes I attended enhanced my ability to identify an opportunity					
6	There was a favorable climate and premises for becoming an entrepreneur at my university					
7	At my university I found many entrepreneurial-minded classmates					

4. Please rate your knowledge of the following with 1 = know nothing at all and 5 = have considerable knowledge:

No	Knowledge of Entrepreneurship	1	2	3	4	5
1	Characteristics of entrepreneurs					
2	Role of entrepreneurs in the world economy					
3	Business ethics					
4	Risk management					
5	Legal structures for ventures (forms of business entities)					
6	Intrapreneurship					
7	Social entrepreneurship					
8	Leadership					
9	Managing teams					
10	Project management					
11	Negotiation					

12	Product development					
13	Product lifecycle					
14	Economies of scale					
15	Feasibility study					
16	Prototype					
17	Intellectual property					
18	Technology commercialization					
19	Patents					
20	Finance and accounting					
21	Venture capital					
22	Equity					
23	Company valuation					
24	Balance sheet					
25	Break even					
26	Income statement					
27	Market research					
28	Competitive analysis					
29	Target market					
30	Product positioning					
31	Product distribution					
32	Advertising and promotion					
33	Sales and selling					
34	Executive summary					
35	Business plan					
36	Business models					
37	Business incubator					

5. Please rate your confidence in your ability to perform the following tasks with 1 = Very low and 5 = Very high:

No	Understanding Entrepreneurial Tasks	1	2	3	4	5
1	Know the steps needed to place a financial value on a new business venture					
2	Pick the right marketing approach for the introduction of a new service					
3	Work with a supplier to get better prices to help a venture become successful					
4	Estimate accurately the costs of running a new project					
5	Recognize when an idea is good enough to support a major business venture					
6	Recruit the right employees for a new project or venture					
7	Convince a customer or client to try a new product for the first time					
8	Write a clear and complete business plan					
9	Convert a useful scientific advance into a practical application					
10	Develop your own original hypothesis and a research plan to test it					
11	Grasp the concept and limits of a technology well enough to see the best ways to use it					
12	Design and build something new that performs very close to your design specifications					
13	Understand exactly what is new and important in a groundbreaking theoretical article					
14	Lead a technical team developing a new product to a successful result					
15	Translate user needs into requirements for a design so well that users will like the outcome					

6. How long have you been a civil engineer? ……..

7. Do you have your own practice?

Yes	
No	

8. If NO, have you considered setting up your own practice?

Yes	
N/A	

9. Gender

Male	
Female	

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